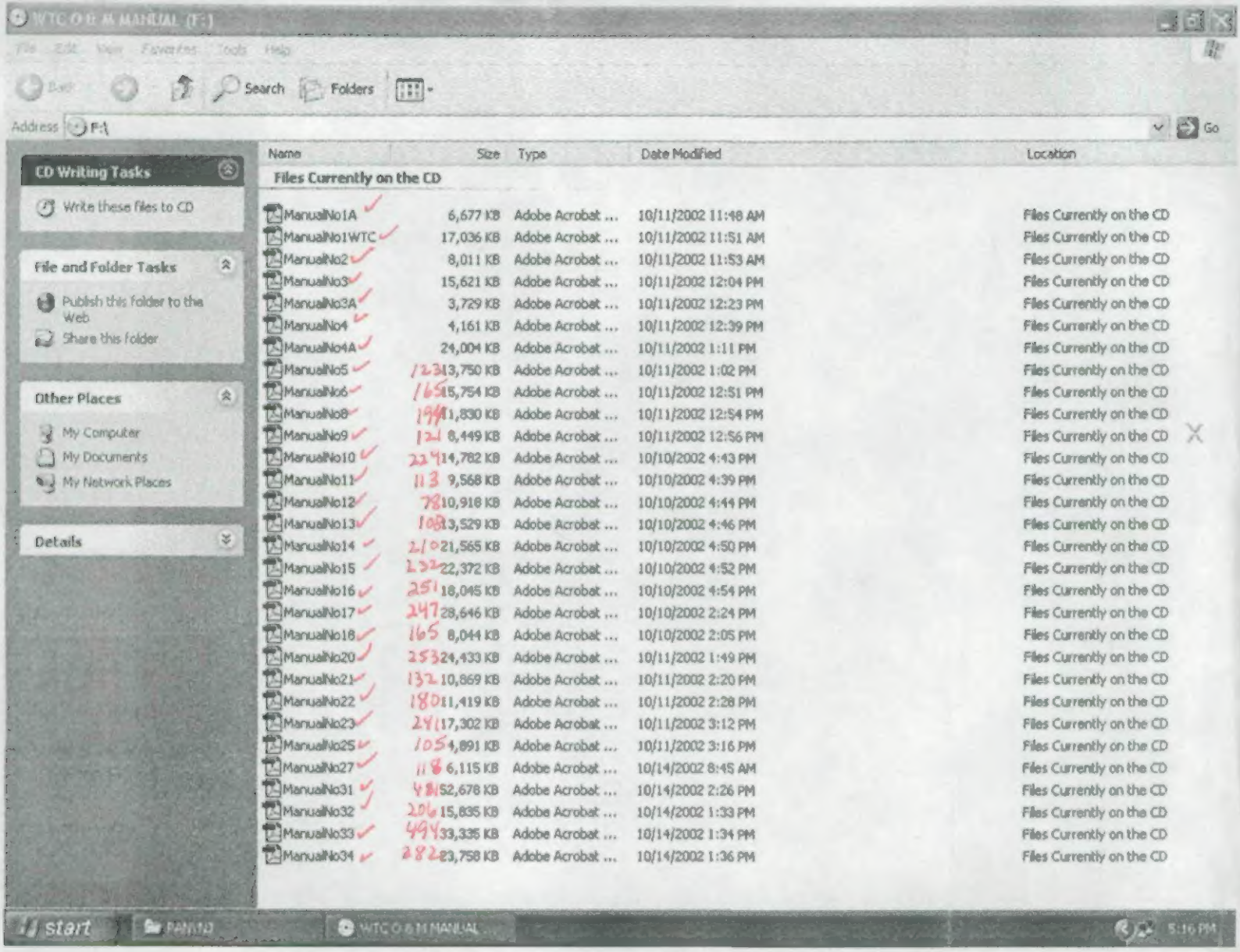

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THE PORT AUTHORITY OF NY & NJ

1 world trade center

Operation & Maintenance

river water pump station

WORLD TRADE CENTER

Instruction Manual No.1

Operation and Maintenance of

RIVER WATER PUMP STATION

Final Edition
Engineering Department
Publication, October 1977

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The material contained herein includes operating and maintenance instructions for all equipment and piping related to the handling of river water within the River Water Pump Station. Also included are instructions for the underground river water piping leading from the pump station to the World Trade Center as well as the effluent piping leading from the World Trade Center to the Hudson River.

The subject matter is intended to serve as a guide for personnel in the performance of their duties in the operation and maintenance of the equipment and systems described. All operating and maintenance personnel must nonetheless comply with all Port Authority accepted safety practices and precautions as well as with the instructions provided by the plant supervisory staff.

The material has been compiled, researched, organized, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department.

CONTENTS

CHAPTER		PAGE
I	INTRODUCTION	
	Scope	I-1
	General	I-1
	General Description Of Pump Station	I-2
	Underground Piping	I-6
	Notes On Appendices	I-8
II	MECHANICAL EQUIPMENT	
	Scope	II-1
	Sluice Gates	II-1
	Traveling Rack Rake And Bar Screen	II-3
	Traveling Screen	II-6
	River Water Pumps	II-9
	Motorized Butterfly Valves	II-15
	Equipment Data	II-16
III	AUXILIARY SYSTEMS	
	Scope	III-1
	Fresh Water System	III-1
	Salt Water System	III-5
	Hypochlorite System	III-8
	Heating And Ventilation	III-11
	Equipment Data	III-12
IV	OPERATIONS	
	Scope	IV-1
	High Tide Emergency Procedures	IV-1
	Pump Station Dewatering Procedures	IV-2

CONTENTS

CHAPTER		PAGE
	Mucking Procedures	IV-5
	Dewatering and Refilling of River Water Piping Systems for Inspection and Repair . .	IV-8
V	ELECTRICAL POWER DISTRIBUTION SYSTEM	
	Scope	V-1
	Normal Power Distribution System	V-1
	Emergency Power Distribution System	V-5
	Motor Control Centers	V-7
	Auxiliary Pump System's Low Voltage Power Supply	V-12
	Subsidiary Systems 120V Power Supply	V-13
	Electric Room's 120V Power Supply	V-14
VI	ELECTRICAL CONTROL SYSTEMS	
	Scope	VI-1
	Main River Water Pumps' Controls	VI-1
	Emergency Pump No. 1 Controls	VI-3
	Emergency Pump No. 2 Controls - Main River Water System	VI-4
	Motorized Valve Controls	VI-5
	Main River Water System Terminal Cabinet 1, Pump Station	VI-7
	Main River Water System Terminal Cabinet 2, Pump Station	VI-7
	Main River Water System Terminal Cabinet, WTC	VI-7
	Auxiliary River Water Pump (No. 8) Controls	VI-7
	Auxiliary Fresh Water Pump Controls.	VI-8

CONTENTS

CHAPTER		PAGE
	Emergency Pump No. 2 Controls - Auxiliary River Water System	VI-8
	Main R.W.P.'s Nos. 4 and 5 Controls - Auxiliary River Water System	VI-9
	Auxiliary River Water System Terminal Cabinet - Pump Station	VI-9
	Auxiliary River Water System Terminal Cabinet - WTC	VI-10
	River Water Pump Shutdown System (60"-20" Header Room Flooding)	VI-10
VII	MAINTENANCE	
	Scope	VII-1
	General	VII-1
	Mechanical Equipment	VII-1
	Electrical Equipment	VII-2
	Maintenance Procedure Cards	VII-5
APPENDIX A	Abbreviations For Text	
APPENDIX B	Electrical Symbols	
APPENDIX C	Mechanical Symbols	
APPENDIX D	Abbreviations For Drawings	
APPENDIX E	Special Legends	
APPENDIX F	World Trade Center Floor Level Inter-Designations	

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
I-1	Pump Station Operating Floor Plan Elevation 302'-0"	I-2
I-2	Pump Station Elevation View	I-2
I-3	River Water Level Alarm Indicators	I-2
I-4	Roof Plan	I-2
I-5	Elevation View Pump Station Intake Structure	I-2
I-6	Underground Piping Plan	I-5
I-7	Underground Piping Profiles Between Pump Station And WTC	I-6
I-8	Underground Piping Profiles Between WTC And Outfall Structure	I-7
II-1	Elevation Views Mechanical Equipment	II-1
II-2	Sluice Gate Operator	II-1
II-3	Torque And Limit Switches Sluice Gate Operator	II-2
II-4	Traveling Rack Rake	II-3
II-5	Traveling Rake Cleaning Cycle	II-4
II-6	Schematic Electrical Control Traveling Rack Rake	II-4
II-7	Traveling Rack Rake Control Cabinet	II-4
II-8	Traveling Screen	II-6
II-9	Traveling Screen Interior View During Cleaning Cycle	II-7
II-10	Traveling Screen Control Cabinet	II-8

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
II-11	River Water Pumps General Arrangement	II-9
II-12	Schematic Pumps And Discharge Headers	II-9
II-13	River Water Pumps Typical	II-9
II-14	Detail View Main System Pumps Nos.1,2,4,5,6,&7	II-9
II-15	Detail View Auxiliary System Pump	II-9
II-16	Cross-Sectional View Main System Pump No. 3	II-9
II-17	Emergency River Water Pump	II-9
II-18	Detail View Emergency Pump	II-9
II-19	Electrical Control Schematic-Motorized Valves For Main River Water Pumps No. 4 & 5	II-13
II-20	Typical Control For Main System Pumps Nos. 4 Or 5	II-13
II-21	Electrical Control Schematic Motorized Valves For Emergency Pump No. 2	II-14
III-1	Flow Diagram Fresh Water System	III-1
III-2	Main Fresh Water Subsystem	III-2
III-3	Domestic And Auxiliary Fresh Water Subsystems	III-2
III-4	Main And Auxiliary Fresh Water Pump Discharge Piping	III-3
III-5	Auxiliary Fresh Water Pump Controls	III-3

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
III-6	WTC Refrigeration Plant Control Panel	III-4
III-7	Auxiliary Fresh Water System Controls	III-4
III-8	Domestic Water Subsystem	III-5
III-9	Flow Diagram Salt Water System	III-5
III-10	Lower Pump Room	III-5
III-11	Traveling Screen Pump Suction Piping	III-6
III-12	Duplex Trash Pumps	III-6
III-13	Cross-Sectional View Duplex Trash Pump	III-6
III-14	Typical Sump Pump	III-7
III-15	Cross-Sectional View Typical Sump Pump	III-7
III-16	Flow Diagram Hypochlorite System	III-8
III-17	Hypochlorite Pumps	III-9
III-18	Typical Hypochlorite Pump	III-9
III-19	Hypochlorite Pump Discharge Piping	III-9
III-20	Hypochlorite Tanks	III-10
III-21	Residual Chlorine Analyzer-Recorder	III-10
V-1	Plan-Electrical Distribution Equipment Operating Floor-Pump Station	V-1
V-2	One Line Diagram Normal Power Distribution System	V-1
V-3	Emergency Low Voltage Feeder and High Voltage Feeder Entrances	V-1

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
V-3A	Power Feeder Designations River Water Pumps	V-2
V-4	Typical High Voltage Motor Starter And High Voltage Disconnect Switch . . .	V-2
V-5	Typical High Voltage Motor Starter And Power Transformers	V-3
V-6	Automatic Transfer Switches And Feeder Transfer Circuit Breakers . .	V-3
V-7	Typical Automatic Transfer Switch Interior View	V-3
V-8	Typical Schematic Diagram Automatic Transfer Switch	V-3
V-9	One Line Diagram Emergency Power Distribution System . . .	V-5
V-10	Emergency Feeder Circuit Breaker	V-6
V-11	Motor Control Centers River Water Pump Station	V-7
V-12	Motor Control Center No. 1, Sections 1 & 2	V-7
V-13	Motor Control Center No. 1, Section 3, And Motor Control Center No. 2, Section 4	V-7
V-14	Motor Control Center No. 2, Sections 5 & 6 And Motor Control Center No. 3, Section 7	V-7
V-15	Motor Control Center No. 3, Sections 8, 9, & 10	V-7
V-16	One Line Diagram Motor Control Center No. 1	V-7
V-17	Unit Heaters And Lighting Panel L-1	V-7

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
V-18	Unit Heaters And Lighting Panel L-1 .	V-7
V-19	Typical Combination Magnetic Starter.	V-8
V-20	One Line Diagram Motor Control Center No. 4	V-9
V-21	Unit Heaters And Lighting Panel L-2	V-9
V-22	Unit Heaters And Lighting Panel L-2 .	V-9
V-23	One Line Diagram Motor Control Center No. 3	V-10
V-24	Lighting And Distribution Panels L-3 & L-5	V-10
V-25	Exit/Emergency Lighting Panel L-3 Interior View	V-10
V-26	Auxiliary Pump System Low Voltage Panel	V-11
V-27	Electric Room 120-Volt Power Supply And Auxiliary Pump System L.V. Power Supply	V-12
V-28	Auxiliary Pump System Low Voltage Panel - Interior View	V-12
V-29	Hypochlorinators, Alarms And Lighting Panel L-4	V-13
V-30	Emergency Feeder Transfer Switch And Subsidiary Systems Transformer . .	V-13
V-31	Panel L-4 And Hypochlorinator Relay Cabinet	V-13
V-32	Hypochlorinators, Alarms, And Lighting Panel L-4 - Interior View ...	V-13
V-33	Solenoid Valve And Convenience Outlets Panel L-5 - Interior View	V-14

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
VI-1	Wiring and Schematic Diagrams Main River Water Pumps (Nos. 1-7) Motor Starters	VI-1
VI-2	Low Water Pressure Indication Relay (R) Details	VI-2
VI-3	Low Water Pressure Indication System Diagram - Main River Water Pumps 1 Thru 7	VI-2
VI-4A	Control Schematic 1 Emergency Pump No. 1	VI-3
VI-4B	Control Schematic 2 Emergency Pump No. 1	VI-3
VI-5A	Control Schematic 1 Emergency Pump No. 2	VI-4
VI-5B	Control Schematic 2 Emergency Pump No. 2	VI-4
VI-5C	Control Schematic 3 Emergency Pump No. 2	VI-4
VI-6A	Wiring Diagram Motorized Valve Control	VI-5
VI-6B	Schematic Diagram - Motorized Valve River Water & Emergency Pumps	VI-5
VI-7	Wiring Diagram - Main River Water System Terminal Cabinet 1 - Pump Station . .	VI-7
VI-8	Wiring Diagram - Main River Water System Terminal Cabinet 2 - Pump Station . .	VI-7
VI-9	Terminal Block Layout - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10A	Wiring Diagram - TB1 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10B	Wiring Diagram - TB2 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
VI-10C	Wiring Diagram - TB3 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10D	Wiring Diagram - TB4 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10E	Wiring Diagram - TB5 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10F	Wiring Diagram - TB6 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10G	Wiring Diagram - TB7 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10H	Wiring Diagram - TB8 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10I	Wiring Diagram - TB9 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10J	Wiring Diagram - TB10 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10K	Wiring Diagram - TB11 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-10L	Wiring Diagram - TB12 - Main R.W.S. Terminal Cabinet - Level B6 - WTC . .	VI-7
VI-11	Wiring & Schematic Diagrams Auxiliary River Water System Pump No. 8 Motor Starter	VI-8
VI-12A	Wiring Diagram - Auxiliary Fresh Water System Relay Cabinet	VI-8
VI-12B	Auxiliary Fresh Water Pump Controls .	VI-8
VI-13A	Wiring Diagram Emergency Pump No. 2 Relay Cabinet. .	VI-9
VI-13B	Electrical Control Schematic- Motorized Valves for Emergency Pump No. 2 . . .	VI-9

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
VI-14A	Wiring Diagram Main River Water Pump No. 4 Relay Cabinet	VI-9
VI-14B	Electrical Control Schematic Motorized Valves for Main River Water Pump No. 4	VI-9
VI-15A	Wiring Diagram - Auxiliary River Water System Terminal Cabinet Pump Station	VI-10
VI-15B	Wiring Diagram - Auxiliary River Water System Terminal Cabinet - Level B6 - WTC	VI-10
VI-16	Wiring and Schematic Diagrams - River Water Pump Shutdown System- 60"-20" Header Room Flooding . . .	VI-10

CHAPTER I

INTRODUCTION

SCOPE

The purpose of this manual is to describe the mechanical and electrical systems of the River Water Pump Station as well as the underground piping associated with the pump station and located on the west side of the perimeter wall surrounding the World Trade Center. River water piping and related equipment located on the east side of the perimeter wall shall be described in a separate manual describing the WTC refrigeration plant. This manual also includes operating and maintenance procedures related to individual items of equipment as well as the entire system.

GENERAL

The River Water Pump Station is located below grade level in the Battery Park City landfill area directly west of the south side of Tower A. Its purpose is to pump salt water from the Hudson River to the WTC refrigeration plant while at the same time removing trash and particles greater than 3/8-inch mesh. Seven 12,900 gpm pumps, the main river water pumps, are used to pump river water through a 60-inch diameter pipeline to as many as seven centrifugal refrigeration machines. One pump has enough capacity to meet the condenser water needs of one centrifugal machine. The pumps also supply water continuously, 24 hours per day, for most of the year to a separate computer cooling system. A single 7400 gpm pump, the auxiliary river water pump, is used as a standby for main river water pumps nos. 1,2,3,6, and 7 whenever the 60-inch discharge line is shut down for repairs. This auxiliary pump as well as the main river water pumps nos. 4 and 5 are able to discharge into a 20-inch line. Pumps nos. 4 and 5 can discharge into either the 60-inch or 20-inch pipelines. For computer cooling purposes, some of the water is pumped

WTCI-5-P

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WORLD TRADE CENTER

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Operation and Maintenance of

RIVER WATER PUMP STATION

DRAFT

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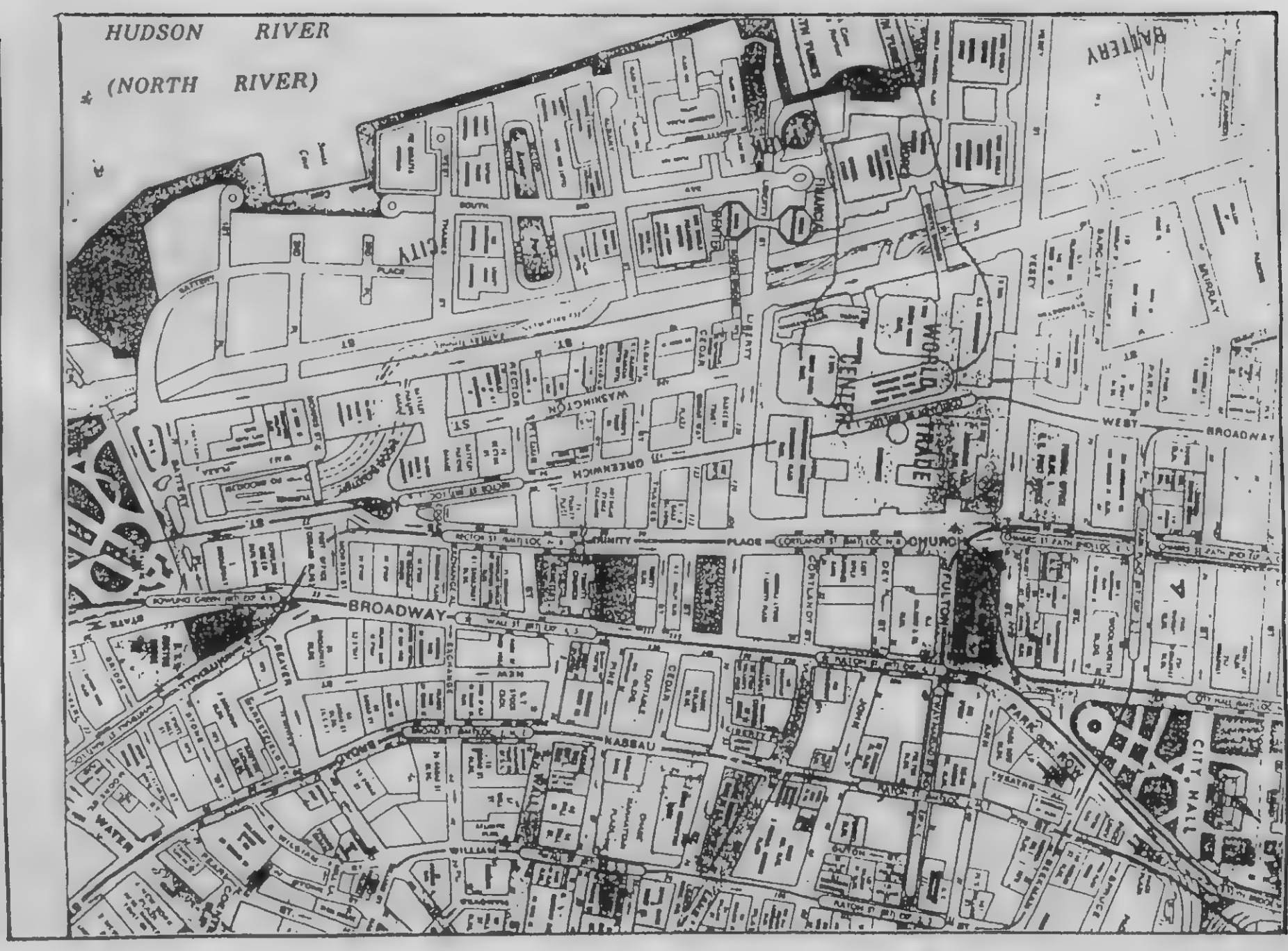
HUDSON RIVER
(NORTH RIVER)
BATTERY
CITY
WORLD TRADE CENTER
WEST BROADWAY
BROADWAY
NASSAU
WATER
CITY HALL

F O R E W O R D

This manual is titled "Instruction Manual No. 1A and replaces Instruction Manual No. 1.

This updated version was necessitated by mechanical and electrical changes to the river water pumping station. The major changes are increased pumping capability, additional controls to achieve pump motor protection with remote annunciation, new water treatment pumps and an entirely new ventilation system. There have also been several changes to the piping system.

In addition, the manual has been entirely rewritten in order to make it a more user-friendly instructive narrative.

The material has been compiled, researched and organized with the tireless aid of the Maintenance Section of the Design Division for Maintenance Engineering, Engineering Department.

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C O N T E N T S

Chapter		Page
1	**INTRODUCTION**	
	Scope	1-1
	General	1-1
	General Description of Pump Station	1-3
	Underground Piping	1-10
	Discharge Water Temperature Control	1-12
	Notes on Appendices	1-13
2	**MECHANICAL EQUIPMENT**	
	Scope	2-1
	General	2-1
	Sluice Gates	2-1
	Traveling Screen	2-5
	River Water Pumps	2-10
	Motorized Butterfly Valves	2-18
	Equipment Data	2-20
3	**AUXILIARY SYSTEMS**	
	Scope	3-1
	General	3-1
	Fresh Water System	3-1
	Salt Water System	3-8
	Hypochlorite System	3-13
	Heating	3-20
	Ventilation	3-20
	Equipment Data	3-22

Chapter		Page
4	**OPERATING PROCEDURES**	
	Scope	4-1
	General	4-1
	High Tide Emergency Procedures	4-1
	Pump Station Dewatering Procedures	4-3
	Mucking Procedures	4-7
5	**ELECTRICAL CONTROL SYSTEMS**	
	Scope	5-1
	Main River Water Pumps' Controls	5-1
	Emergency Pump No. 1 Controls	5-5
	Emergency Pump No. 2 Controls	5-7
	Motorized Valve Controls	5-7
	Main River Water System Terminal Cabinet-1, Pump Station	5-8
	Main River Water System Terminal Cabinet-2, Pump Station	5-11
	Main River Water System Terminal Cabinet-WTC	5-12
	Auxiliary River Water Pump (No. 8) Controls	5-12
	Emergency Pump No. 2 Controls - Auxiliary River Water System	5-13
	Auxiliary River Water Pumps System Terminal Cabinet Pump Station	5-14
	Auxiliary River Water Pumps System Terminal Cabinet - WTC	5-16
	River Water Pump Shutdown System - (60"-20" Header Room Flooding)	5-17

6 ELECTRICAL POWER DISTRIBUTION SYSTEM

Scope 6-1
General 6-1
Power Transformer Upgrading 6-2
Normal Power Distribution System . . . 6-3
Emergency Power Distribution System . . 6-10
Motor Control Centers 6-12
Auxiliary Pump System's Low Voltage Power Supply 6-20
Subsidiary System 120 Voltage Power Supply 6-22
Electric Riser 120 Volt Power Supply . 6-23

7 MAINTENANCE

Scope 7-1
General 7-1
Mechanical Equipment 7-2
Electrical Equipment 7-3
Maintenance Procedure Cards 7-8

8. TROUBLESHOOTING

Scope 8-1
General 8-1
Pumps 8-2
Exhaust Fan Motor Control System . . . 8-5

CHAPTER 1

INTRODUCTION

SCOPE

The purpose of this manual is to describe the mechanical and electrical systems of the River Water Pump Station and the underground piping associated with the pump station located on the west side of the perimeter wall surrounding the World Trade Center.

River Water piping and related equipment located on the east side of the perimeter wall is addressed in a separate manual describing the WTC refrigeration plant.

This manual includes operating and maintenance procedures related to individual items of equipment and the entire system.

GENERAL

The River Water Pump Station is located below grade level in the Battery Park City landfill area directly west of the south side of 2 World Trade Center. It pumps salt water from the Hudson River to the WTC refrigeration plant after removing trash and particles greater than 3/8-inch mesh.

There are 8 main river water pumps. Pumps 1, 4, 5 and 8 can deliver 12,900 GPM to either the 60" or the 20" pipe feeding the World Trade Center refrigeration plant and the 24-hour computer cooling system. Pumps 2, 3, 6 and 7 deliver 18,000 GPM to the 7 centrifugal refrigeration machines.

For computer cooling purposes, some of the water is pumped through a pair of heat exchangers located on the 264-foot level (B4) of the WTC basement to produce chilled water for cooling various computer rooms located throughout the WTC complex.

In the event of a general electric power failure at the WTC, all of the main and auxiliary river water pumps will shut down, but two small 1290 GPM pumps, the emergency river water pumps, will automatically start up and supply just enough water to cool two groups of diesel-driven electric power generators located on the 242-foot level (B6) of the WTC. One group of generators is controlled and operated by the Port Authority. The second group of generators is controlled and operated by The New York Telephone Company.

The pump station serves the WTC by means of two underground pipelines: a 60-inch pipe and a 20-inch pipe. The 60-inch pipe is used primarily by the main river water pumps and the 20-inch pipe is used primarily for computer cooling and also serves as a standby whenever the 60-inch pipeline is out of service for any reason. The piping within the basement of the WTC is so arranged that either of the two

pipes may be used to supply water for the centrifugal machines or for computer cooling.

GENERAL DESCRIPTION OF PUMP STATION

General

The pump station is an underground building approximately 67 feet wide by about 100 feet long. The roof of the structure is called Pumphouse Park. The operating floor, located 2 feet above the river median high water level, contains most of the mechanical and electrical equipment. See figures 1-1 through 1-5. For reference purposes, the median high water level is 300 feet.

River water enters the pump station through a north and south horizontal intake tunnel each 7-foot high x 10-foot wide. The tunnels on the inlet side penetrate one of the circular steel cells surrounding the Battery Park City landfill area. The bottoms of the tunnels are flush with the bottom of the pump station chambers at a level of 280 feet. Both tunnel inlets are equipped with monel bar screens containing bars spaced at 5-inch intervals. River water then enters the pump station through a pair of sluice gates and passes to the north and/or south settling chambers. Due to the much greater cross-sectional areas of the settling chambers as compared to the areas of the intake tunnels, the velocity of the water is reduced. This reduction in water

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F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide Port Authority personnel who operate and maintain the Remote Lighting Control System at the World Trade Center.

This manual should be used with, and must comply with, instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

The Remote Lighting Control System for the Southeast Plaza Building of the World Trade Center complex is not included in this manual since it was not installed at the time of preparation of this manual.

World Trade Center personnel should request an updating of this manual when the system is completely installed or other major changes are made.

CONTENTS

CHAPTER		PAGE
I	INTRODUCTION	
	Scope	I-1
	General Description Of System	I-1
	Power Supply	I-2
	Equipment Arrangement	I-2
	Notes On Appendices	I-3
II	SYSTEM EQUIPMENT	
	Scope	II-1
	General	II-1
	Control Center Overall Description	II-1
	Lighting Control Panel	II-2
	Digital Computers	II-5
	Central Multiplex Terminals	II-7
	Link Control Unit	II-7
	Teletype Keyboard And Printer	II-7
	Alarm Display And Acknowledge Terminal	II-9
	Data Transmission Links	II-10
	Remote Multiplex Terminal Cabinets	II-10
	Subrelay Stations	II-11
	Terminal Strip Cabinets	II-11
	Lighting Contactors	II-12
	Local Control Key-operated Switch Stations	II-12
	System Power Supply Units	II-12

CONTENTS

CHAPTER		PAGE
III	SYSTEM DISTRIBUTION	
	Scope	III-1
	System Power Supply Distribution	III-1
	Signal Distribution In Data Transmission Cables	III-2
	Remote Multiplex Terminal/ Subrelay Station Distribution	III-4
	Subgrade Level Distribution	III-4
	Concourse Level Distribution	III-5
	Tower A Distribution	III-5
	Tower B Distribution	III-6
	Northeast Plaza Building Distribution	III-6
	Provision For Future Additional Distribution . .	III-7
IV	SYSTEM OPERATION	
	Scope	IV-1
	General	IV-1
	Master System Control Switch	IV-1
	Automatic Time Clock Lighting Control	IV-2
	Manual And Semiautomatic Lighting Control	IV-6
	Miscellaneous Monitoring Operations	IV-10
	Lighting Control Circuit Operation	IV-12
V	MAINTENANCE	
	General	V-1
	Items Of Equipment	V-3

CONTENTS

CHAPTER		PAGE
APPENDIX A	Abbreviations For Text	
APPENDIX B	Electrical Symbols	
APPENDIX C	Abbreviations For Drawings	
APPENDIX D	Special Abbreviations	
APPENDIX E	World Trade Center - Floor Level Inter-Designations	

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
I-1	Block Diagram Remote Lighting Control System	I-1
I-2	Part Plan Security Room - Elevation 294 Feet	I-2
I-3	Typical Floor Plan Towers A & B	I-2
I-4	Typical Floor Plan Northeast Plaza Building	I-2
II-1	Remote Lighting Control Center Equipment Security Room	II-2
II-2	Lighting Control Panel Control Console	II-2
II-2a	Legend Lighting Control Panel - Control Console . . .	II-2
II-3	Maintenance Access Panel Control Console	II-6
II-3a	Legend Maintenance Access Panel	II-6
II-4	Teletype Keyboard And Printer Control Center - Security Room	II-7
II-5	Teletype Keyboard And Printer Partial View	II-7
II-6	Alarm Display And Acknowledge Terminal Control Center - Security Room	II-9
II-7	Data Transmission Cable Details	II-10
II-8	Typical RMT & TSC Cabinets Exterior Views - Towers A & B	II-10
II-9	Remote Multiplex Terminal Cabinet Interior View	II-10
II-10	Typical Subrelay Station and Terminal Strip Cabinet - Exterior Views - Towers A And B	II-11

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
II-11	Typical Subrelay Station Interior View	II-11
II-12	Typical Terminal Strip Cabinet Interior View - Towers A And B	II-11
II-13	Typical Terminal Strip Cabinet Interior View - Northeast Plaza Building	II-11
II-14	Lighting Contactors - Arrangement 1 Lighting Panel	II-12
II-15	Lighting Contactor - Arrangement 2 Lighting Panel	II-12
II-16	Typical Lighting Contactor Lighting Panel	II-12
II-17	Lighting Contactor - Arrangement 3 Lighting Panel	II-12
II-18	Schematics Lighting Contactor Switching Circuit	II-12
II-19	Typical Local Control Key-operated Switch Station - Freight Elevator Lobby - Towers A & B	II-12
II-20	Typical Local Control Key-Operated Switch Station - Freight Elevator Lobby - Floors 2 To 8 - NEPB	II-12
II-21	Local Control Key-operated Switch Station Freight Elevator Lobby - Floor 9 - NEPB	II-12
II-22	Typical System Power Supply Cabinet Exterior View	II-13
II-23	Typical System Power Supply Units	II-13
III-1	Distribution Diagram - System Power Supply A Tower A - Floor 108	III-1
III-2	Distribution Diagram - System Power Supply B Tower A - Floor 76	III-1
III-3	Distribution Diagram - System Power Supply C Tower A - Floor 76	III-1

ILLUSTRATIONS

FIGURE		*FOLLOWS PAGE*
III-4	Distribution Diagram - System Power Supply D Tower A - Floor 42	III-1
III-5	Distribution Diagram - System Power Supply E Tower A - Floor 7	III-1
III-6	Wiring Diagrams System Power Supply/RMT Distribution	III-1
III-7	Distribution Diagram - System Power Supply F Tower B - Floor 108	III-2
III-8	Distribution Diagram - System Power Supply G Tower B - Floor 76	III-2
III-9	Distribution Diagram - System Power Supply H Tower B - Floor 42	III-2
III-10	Distribution Diagram - System Power Supply I Tower B - Floor 42	III-2
III-11	Distribution Diagram - System Power Supply J Tower B - Floor 7	III-2
III-12	Distribution Diagram - System Power Supply K Northeast Plaza Building - Floor 9	III-2
III-13	Distribution Diagram - System Power Supply L Electrical Distribution Room 2- Concourse Level	III-2
III-14	RMT 1, Link L, And SPS Unit L Concourse Level- Electrical Distribution Room 2	III-2
III-15	Typical Remote Multiplex Terminal Hung Ceiling - Concourse Level	III-2
III-16	Typical Wiring Diagram Control Console/RMT/RMT	III-3
III-17	Typical Wiring Diagram Control Console/RMT/RMT With Line Terminator .	III-3
III-18	Data Transmission Cable Diagrams Links A And B - Tower A	III-3
III-19	Data Transmission Cable Diagrams Links C And D - Tower A	III-3

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
III-20	Data Transmission Cable Diagrams Link E, Tower A - And Link F, Tower B	III-3
III-21	Data Transmission Cable Diagrams Links G And H - Tower B	III-3
III-22	Data Transmission Cable Diagrams Links I And J - Tower B	III-3
III-23	Data Transmission Cable Diagrams Link K, NEPB - And Link L, Concourse Level . .	III-4
III-24	Lighting Control Wiring Diagrams RMT/Subrelay Stations	III-4
III-25	RMT/Subrelay Station Data Tower A	III-4
III-26	RMT/Subrelay Station Data Tower B	III-4
III-27	RMT/Subrelay Station Data Northeast Plaza Building	III-4
III-28	Distribution Diagram - Remote Lighting Control System - Concourse And Subgrade Levels	III-4
III-29	Distribution Diagram - Remote Lighting Control System - Concourse Level	III-5
III-30	Distribution Diagram Remote Lighting Control System - Tower A . . .	III-5
III-31	Distribution Diagram Remote Lighting Control System - Tower B . . .	III-6
III-32	Distribution Diagram Remote Lighting Control System - NEPB	III-6
IV-1	Time Clock Control Bypass Codes Auto Computer	IV-5
IV-2	Enable/Disable Codes Vertical Panel Computer	IV-10
IV-3	Typical Lighting Control Wiring Schematics Towers A And B	IV-12

CHAPTER I

INTRODUCTION

SCOPE

This manual deals with the Remote Lighting Control System of the tenant office areas at the World Trade Center. Chapter I provides a general description of the system, power supply, and equipment arrangement. Chapter II describes the individual items of equipment employed in the Local and Remote Lighting Control Systems. Chapter III focuses on the system power supply, signal, remote multiplex terminal/subrelay station, and overall system distribution. Chapter IV explains the system operation under various conditions. Chapter V includes maintenance recommendations. This manual does not describe the security and alarm systems, even though some of the equipment described herein also functions for those systems.

GENERAL DESCRIPTION OF SYSTEM

The Remote Lighting Control System at the World Trade Center provides the capability of performing ON/OFF lighting control for 200 tenant floors from a single control point, the Control Center in the Security Room on subgrade level B1 (elevation 294 feet). There is also a provision for the local control of tenant floor lights by means of key-operated switches on the individual floors and by means of toggle switches on some floors. The Remote Lighting Control System consists of a control console, teletype keyboard and printer (TTY), alarm display and acknowledge terminal (ADAT), data transmission cables (DTC's), system power supply (SPS) units, remote multiplex terminals (RMT's), subrelay stations (R's), and lighting contactors. Some of these components are shown in the system block diagram presented in Figure I-1. The control console consists of dual general purpose computers, dual central multiplex terminals (CMT's), a link control unit, and a

WTCI-5-P

208 pages

WORLD TRADE CENTER

Instruction Manual No. 3

Operation and Maintenance of

MECHANICAL SYSTEMS
CENTRAL REFRIGERATION PLANT

Final Edition
Engineering Department
Publication, December 1978

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

This manual provides mechanical operating and maintenance instructions for the refrigeration equipment and related systems within the WTC Refrigeration Plant. Electrical operating and maintenance instructions for the compressor motors and pump motors as well as for the power distribution equipment supplying those motors are provided in a separate manual.

The subject matter is intended to serve as a guide for personnel in the performance of their duties in the operation and maintenance of the equipment and systems described. All operating and maintenance personnel must nonetheless comply with all Port Authority accepted safety practices and precautions as well as with the instructions provided by the plant supervisory staff.

The material has been compiled, researched, organized, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

P R E F A C E

This manual reflects the as-built condition of the systems as of the date when each chapter was researched and investigated. Due to modifications that may have been made after that time, the manual may contain some discrepancies which may require an updating of the manual in the future. The World Trade Department should request an updating of the manual when it is felt that the manual no longer adequately represents the Refrigeration Plant and related systems in their current state.

C O N T E N T S

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Compressor, Gearbox, and Motor	1-2
	Single-Cooler Centrifugal Machines	1-2
	Dual-Cooler Centrifugal Machine	1-3
	Chilled Water Systems	1-4
	Condenser Water System	1-4
2	COMPRESSOR, GEARBOX, AND MOTOR	
	Scope	2-1
	Compressor	2-1
	Speed—Increasing Gear	2-10
	7,000 Horsepower Motor	2-12
3	SINGLE-COOLER CENTRIFUGAL MACHINES	
	Scope	3-1
	Introduction	3-1
	General Description	3-5
	Sound Attenuation	3-12
	Unit Control Panel	3-13
	Operating Procedures	3-26
	Electrical Operating Sequence	3-34
	Startup Summary	3-42
	Purge System	3-43
	Pumpout System	3-44

C O N T E N T S

Chapter		Page
4	DUAL-COOLER CENTRIFUGAL MACHINE	
	Scope	4-1
	General Description	4-1
	Unit Control Panel	4-5
	Pneumatic Controls	4-8
	Startup Procedures	4-12
	Electrical Operating Sequence	4-16
5	CHILLED WATER AND RIVER WATER SYSTEMS	
	Scope	5-1
	Chilled Water Systems	5-1
	River Water System	5-7
	Auxiliary Water Cooling System	5-14
6	MAINTENANCE	
	Scope	6-1
	General	6-1
	Mechanical Equipment	6-1

APPENDIX A Abbreviations For Text

APPENDIX B Mechanical Symbols

APPENDIX C Abbreviations For Drawings

APPENDIX D Electrical Symbols

APPENDIX E World Trade Center
Floor Level Inter-Designations

ILLUSTRATIONS

Figure		Follows Page
1.1	World Trade Center - Below Grade	1-1
2.1	Compressor, Gear, and Motor	2-2
2.2	Compressor Oil Sump	2-2
2.3	Compressor Suction - Side View	2-2
2.4	Pneumatic Control Schematic	2-2
2.5	Compressor Lubrication Schematic	2-3
2.6	Compressor Oil Cooler	2-5
2.7	Oil Filters and Piping	2-5
2.8	Auxiliary Oil Pump and Filters Detail View	2-6
2.9	Gear and Motor	2-10
2.10	Gear Auxiliary Oil Pump	2-10
2.11	Gear Lubrication Schematic	2-10
2.12	Gear Oil Cooler and Piping	2-10
2.13	Gearbox - Rear View	2-11
2.14	Motor Lubrication Schematic	2-13
2.15	Motor Oil Pump and Cooler	2-13
3.1	Centrifugal Refrigeration Machine Motor and Purge Unit	3-2
3.2	Centrifugal Machine Flow Diagram	3-2
3.3	Centrifugal Refrigeration Machine Chilled Water Valves	3-2
3.4	Centrifugal Refrigeration Machine Compressor Suction and Discharge Piping . . .	3-2
3.5	Condenser Water Piping	3-2
3.6	Interstage Butterfly Valve and Controller . .	3-3

ILLUSTRATIONS

Figure		Follows Page
3.7	Interstage Butterfly Valve Controls Rear View	3-3
3.8	Prerotation Vane Controller	3-3
3.9	Interstage Liquid Injection Controls	3-4
3.10	Hot Gas Bypass Piping	3-5
3.11	Purge Unit and Liquid Level Gauge	3-6
3.12	Unit Control Panel Front View	3-6
3.13	Unit Control Panel Rear View	3-7
3.14	Electrical Schematic Centrifugal Machine Controls	3-23
3.15	Startup Timer Schedule	3-36
3.16	Purge Unit Detail View	3-44
3.17	Pumpout Compressor and Receiver	3-44
3.18	Pumpout System Schematic	3-45
3.19	Pumpout Compressor, Cooler, and Control Valves	3-45
3.20	Pumpout Compressor Rear View	3-45
3.21	Pumpout Compressor Controls	3-45
4.1	Dual Cooler Centrifugal Machine Flow Diagram	4-1
4.2	Low-zone and High-zone Evaporators	4-1
4.3	Condenser and Intercooler/Receiver	4-2
4.4	Float Valve Chamber and Intercooler/Receiver	4-2
4.5	Evaporators and Liquid Level Controls	4-3

ILLUSTRATIONS

Figure		Follows Page
4.6	Pneumatic Control Schematic	4-3
4.7	Evaporators and Piping	4-4
4.8	Compressor Suction and Discharge Piping . . .	4-4
4.9	Unit Control Panel Front View	4-5
4.10	Unit Control Panel - Rear View	4-5
4.11	SPV Control Mode Selector Switches	4-5
4.12	Unit Control Panel Relays and Pressure Switches	4-5
4.13	Electrical Schematic Dual Cooler Centrifugal Machine	4-16
5.1	Chilled Water Flow Diagram	5-1
5.2	Chilled Water Pump Typical	5-2
5.3	Chilled Water Pump Typical Side View	5-2
5.4	Chilled Water Pump Motor	5-2
5.5	Chemical Feed Tank	5-4
5.6	Condenser Water and Auxiliary Water Flow Diagram	5-7
5.7	Automatic Strainer Side View	5-8
5.8	Automatic Strainers Top View	5-8
5.9	Automatic Strainer Cross-sectional View	5-8
5.10	Automatic Strainer Elevation View	5-8
5.11	Automatic Strainer Control Panel	5-9

ILLUSTRATIONS

Figure		Follows Page
5.12	Automatic Strainer Control Schematic	5-9
5.13	Auxiliary Water Coolers	5-14
5.14	Auxiliary Cooling Water Pumps	5-14
5.15	Auxiliary Cooling Water System Temperature Gauges	5-14
5.16	Auxiliary Water Schematic	5-15

120

WTCI-5-P

WORLD TRADE CENTER

Manual No. 3A

Operation and Maintenance

MECHANICAL SYSTEMS
CENTRAL REFRIGERATION PLANT
(Supplementary Manual for the 2,500-Ton Chillers)

FOR REVIEW ONLY
(UPDATED COPY)

Engineering Department
Publication, ***JULY 1990***

THE PORT AUTHORITY OF NY & NJ

P R E F A C E

This manual describes the systems and operating procedures in use at the issue date of the manual. Future systems changes will require revisions in the manual. The World Trade Department should request changes in the manual as refrigeration-plant systems change.

F O R E W O R D

This manual gives mechanical operating and maintenance instructions for the 2,500-ton centrifugal chiller, refrigeration equipment, and related systems. Another manual gives electrical operating and maintenance instructions for the compressor motors and pump motors as well as instructions for the power-distribution equipment supplying those motors.

This manual is a guide for operating and maintenance personnel who must also comply with Port Authority accepted safety procedures and instructions from their supervisory staff.

C O N T E N T S

Chapter		Page
1	**INTRODUCTION**	
	Scope	1-1
	General	1-1
	Single-Cooler Centrifugal Chillers	1-2
	System Controls	1-5
2	**COMPRESSOR, GEARBOX, AND MOTOR**	
	Scope	2-1
	Compressor	2-1
	Speed-Increasing Gear	2-16
	2,000-Horsepower Motor	2-19
3	**SINGLE-COOLER CENTRIFUGAL CHILLERS**	
	Scope	3-1
	General	3-1
	Unit Control Panel	3-10
4	**CHILLED-WATER AND RIVER-WATER SYSTEMS**	
	Scope	4-1
5	**MAINTENANCE**	
	Scope	5-1
	General	5-1
	Mechanical Equipment	5-1

APPENDIX A List of Illustrations
APPENDIX B Abbreviations for Text
APPENDIX C Mechanical Symbols
APPENDIX D Abbreviations for Drawings
APPENDIX E Electrical Symbols
APPENDIX F World Trade Center Floor-Level Inter-designations

WTCI-5-P

117 pages

WORLD TRADE CENTER

Manual No. 4

Operation and Maintenance

ELECTRICAL SYSTEMS

CENTRAL REFRIGERATION PLANT

Final Edition
Engineering Department
Publication, December 1977
Reprinted, November 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to Port Authority personnel who operate and maintain the Electrical Systems of the Central Refrigeration Plant in the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures applicable to the World Trade Center. Supplementary, detailed information on the major components of the Electrical Systems of the Central Refrigeration Plant is supplied in Manual No. 4a.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

The information and diagrams provided in this manual reflect the status of the equipment and circuitry as it existed upon the completion of research for the manual.

World Trade Center personnel should request revisions to this manual for all changes to equipment and circuitry that have occurred since that time.

CONTENTS

Chapter		*Page*
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Notes on Appendices	1-2
2	MAIN POWER DISTRIBUTION SYSTEM	
	Scope	2-1
	One-Line Diagram Discussion	2-1
	Power Centers	2-3
	Removable Circuit Breaker Element	2-4
	2000 KVA Transformers	2-7
	Hottest Spot Indicator	2-8
	River Water Pump Contactors	2-10
	River Water Pump Controls and Indicators	2-12
	Chilled Water Pump Controllers	2-13
3	7,000 HP COMPRESSOR MOTORS AND SWITCHGEAR	
	Scope	3-1
	General	3-1
	Synchronous Motor Theory	3-1
	7,000 hp Compressor Motors	3-3
	7,000 hp Motor Starter Switchgear	3-4
	Circuit Breakers	3-13

CONTENTS

Chapter		Page
4	480V POWER DISTRIBUTION SYSTEM	
	Scope	4-1
	One-Line Diagram Discussion	4-1
	Emergency Break-Glass Circuit	4-12
	Motor Control Center	4-12
5	DIRECT CURRENT POWER SUPPLIES	
	Scope	5-1
	General	5-1
	Power Centers DC Supply	5-1
	7,000 hp Motor Starters DC Supply	5-4
	APPENDIX A Abbreviations For Text	
	APPENDIX B Electrical Symbols	
	APPENDIX C Abbreviations For Drawings	
	APPENDIX D Special Legend	
	APPENDIX E World Trade Center Floor Level Inter-Designations	

ILLUSTRATIONS

Figure		Follows Page
1-1	Location Plan Central Refrigeration Plant	1-2
2-1	One Line Diagram 13.8 KV Power Distribution System	2-1
2-2	Typical Power Center	2-1
2-3	Typical 13.8 KV ACB	2-4
2-4	Schematic Typical 13.8 KV ACB Elevating Circuit	2-4
2-5	Typical 13.8 KV ACB Operating Mechanism Left and Front Views	2-4
2-6	Typical 13.8 KV ACB Operating Mechanism Right Side View	2-4
2-7	Typical Operating Mechanism with Closing Spring Removed - Left Side View	2-4
2-8	Schematic Typical 13.8 KV ACB Spring Charging Circuit . .	2-5
2-9	Schematic Typical 13.8 KV ACB Tripping Circuit	2-6
2-9A	Typical 13.8 KV ACB Control Panel	2-6
2-10	Wiring and Development Typical Stationary Auxiliary Switch	2-6
2-11	Typical 13.8 KV ACB Breaker Compartment Terminal Boards	2-6
2-12	Typical Hottest Spot Indicator	2-8
2-13	Typical River Water Pump Contactor and Chilled Water Pump Controller Interior View With Contactor Open and in Ground Position	2-10
2-14	Typical Magnetic Contactor	2-10

ILLUSTRATIONS

Figure		Follows Page
2-15	Typical Contactor Power Compartment Interior View with Contactor Withdrawn	2-10
2-16	Schematic Typical River Water Pump Contactor	2-10
2-17	Central Control Panel	2-13
2-18	Schematic Typical Chilled Water Pump Controller	2-13
2-19	Wiring Diagram Chilled Water Pump Controls	2-15
3-1	Typical 7,000 hp Synchronous Motor	3-3
3-2	Typical 7,000 hp Motor Starter Switchgear . . .	3-4
3-3	Typical 7,000 hp Motor Starter Switchgear Feeder Compartment	3-4
3-4	Typical 7,000 hp Motor Starter Control Panel . .	3-5
3-5	Schematic Typical 7000 hp Motor Starter	3-5
3-6	Schematic - Typical Refrigeration Machine Control Circuit - Single Cooler System	3-5
3-7	Schematic - Refrigeration Machine Control Circuit - Dual Cooler System	3-5
3-8	Typical 7,000 hp Motor Starter Switchgear Interior View - Reactor and Low Voltage Contactor Compartments	3-5
3-9	Typical Run Circuit Breaker and Cubicle	3-5
3-10	Typical Run Circuit Breaker Cubicle Component Location	3-5
3-11	Typical Start Circuit Breaker and Cubicle . . .	3-5
3-12	Typical Motor Terminal Box Interior View	3-5

ILLUSTRATIONS

Figure		Follows Page
4-1	One-Line Diagram 480V Distribution System	4-2
4-2	Panel Layout 480V Distribution System	4-2
4-3	Schematic Break-Glass Relay	4-12
4-4	Motor Control Center	4-12
4-5	One-Line Diagram Motor Control Center	4-13
4-6	Air Compressor No. 3 Emergency Transfer Switch	4-13
4-7	Schematic - Air Compressor Motor Controller Circuit	4-14
4-8	Schematic - Auxiliary Water Pump Motor Controller Circuit	4-14
4-9	Schematic - Condensate Pump No. 1 Motor Controller	4-14
4-10	Schematic - Air Dryers Motor Contactor Circuit	4-14
5-1	Power Centers DC Supply	5-1
5-2	7,000 hp Motor Starters DC Supply	5-1
5-3	Schematic Power Centers DC Supply	5-1
5-4	Schematic 7,000 hp Motor Starters DC Supply	5-3

CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the electrical power distribution systems in the Central Refrigeration Plant of the World Trade Center. Chapter 1 is an introduction to the manual. It includes a layout showing the locations of all the major electrical equipment in the refrigeration plant. Chapter 2 deals with the distribution of the 13.8 KV main power to the 7,000 hp. compressor motors. Included in this chapter are detailed descriptions of the power centers located on the mezzanine level of the refrigeration plant and a foldout one-line diagram of the 13.8 KV Main Power Distribution System.

Chapter 3 focuses on the refrigeration motor starters that control, operate, and protect the 7,000 hp. compressor motors. The chapter contains a foldout schematic of a typical refrigeration motor starter (7,000 hp. Motor Starter Switchgear) and York Unit Control Panels. Chapter 4 is concerned with the 480V Power Distribution Systems in the plant. Included in the chapter are a one-line diagram of the distribution system, schedules of the distribution panels in the system and information concerning the Motor Control Center. Chapter 5 is devoted to the dc power supplies which provide the 48V dc power that is required for controlling, tripping, and closing operations in the power centers and the motor starters.

GENERAL

The Main Power Distribution System for the Central Refrigeration Plant comprises seven feeders that supply power to

seven power centers located in the refrigeration plant. See Figure 1-1. The seven power centers control the power required for the heavy cooling equipment motors. These motors include the 7,000 hp. synchronous motors that drive the refrigeration compressors, the Chilled Water Circulating Pumps, and the River Water Pumps that are located in the River Water Pump Station. Detailed information concerning the power centers is provided in Chapter 2.

Each of the seven synchronous motors is provided with its own switchgear cabinet. Housed in this cabinet are two drawout air circuit breakers, relays, switches, and miscellaneous associated electronic and electromechanical components. Detailed information concerning the Motor Starter Switchgear is provided in Chapter 3.

The 480V Power Distribution System feeds many auxiliary systems associated with the refrigeration plant. Feeders for this system originate in Substations 294A and 294B and terminate in distribution panels located on the northwest wall of the plant. See Figure 1-1.

NOTES ON APPENDICES

Appearing in the rear of this manual are four appendices. They are: "Abbreviations for Text", "Electrical Symbols", "Abbreviations for Drawings", and "Special Legend". The "Abbreviations for Text" listing comprises the explanations of all the standard abbreviations used in the writing of the text of this manual. The "Abbreviations for Drawings" legend contains definitions of the standard abbreviations utilized in the diagrams in the manual. The "Electrical Symbols" listing contains the meanings of all the standard electrical symbols used in the diagrams in this manual. The "Special Legend" includes explanations of all the special electrical designations and symbols originated specifically for the subject matter in this manual.

404 pages

WORLD TRADE CENTER

Instruction Manual No. 4a

SUPPLEMENTARY PUBLICATIONS

ELECTRICAL SYSTEMS
CENTRAL REFRIGERATION PLANT

Engineering Department
Publication, November 1976

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WORLD TRADE CENTER

Instruction Manual No. 4a

SUPPLEMENTARY PUBLICATIONS

ELECTRICAL SYSTEMS
CENTRAL REFRIGERATION PLANT

Engineering Department
Publication, November 1976

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

This book has been compiled by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, at the request of the Electrical Section of the Operations Division of the World Trade Department as a supplement to World Trade Center Instruction Manual No. 4, "Electrical Systems - Central Refrigeration Plant".

The publications and diagrams included in this book contain manufacturers' data pertaining to the receiving, handling, storing, installing, maintaining, adjusting, and servicing of most of the major assemblies and subassemblies comprising the electrical systems of the Central Refrigeration Plant. Since the data contained in these manufacturers' drawings and publications have not been verified by the Maintenance Methods Section, their accuracy cannot be assured.

CONTENTS

Title	Publication or Drawing No.	Tab No.
Instructions and Recommended Parts for Maintenance — Metal-Clad Switchgear, Types M26 and M36	GEH-1802V	1
Instructions — Magne-Blast Circuit Breaker, Type AM-13.8-1000-3H	GEI-88766	1
Installation — Types AB-16,-40, -41, DB-16,-30,-40,-41 Ammeters and Voltmeters	198 4555K10-001E	1
Instructions — Distribution Surge Arresters	GEH-2906B	1
Instructions — Instrument Transformers, Butyl-Molded and Other Dry Types	GEH-230AD	1
Instructions—Thyrite Secondary Protector	GEI-19126D	1
Instructions—Ventilated Dry-Type Transformers	GEK-5673	2
Instructions— Overload Indicator for Ventilated Dry-Type Transformers	GEI-65079A	2
Nameplate — 13.8-2.4 KV Dry-Type Transformer	NP 223A7065	2
Instructions — Control and Transfer Switch, Type SBM	GEH-2038A	3
Recommended Renewal Parts — Breaker Element and Switchgear	SLS-7539	3

Title	*Publication or Drawing No.*	*Tab No.*
Instructions — 1C7160 Limitamp Controllers with Draw-Out Air-Break Contactor	GEH-309IC	3
Instructions — High Voltage Contactors, AC Air-Break Type	GEH-3102C	3
Renewal Parts — 1C2814-E Contactors	GEF-4337B	3
Instructions — Switchgear SCR Battery Chargers	GEK-1250B	3
Elementary Diagram	0165B6006 Sheets 1 thru 6	4
Connection Diagrams — Metal-Clad Switchgear	0109D3165 0109D3166 0109D3167	4
Nameplate — 15 KVA Transformer	9T21A9302DAG9	5
Nameplate — 45 KVA Transformer	9T23Y3873DAG03	5
Nameplate—112.5 KVA Transformer	9T23Y3875DAG03	5
Installation and Operating Instructions—Dry-Type General Purpose Transformers	GEK-33276B GEK-33277A	5
Selection and Installation Instructions — Applying Commercially Available Connectors to Type QL or Type QL-C Transformers	GEK-33278A	5
Instructions — Metal-Clad Switchgear, Type 5HK, 7.5HK, and 15 HK	IB-8.2.7-1	6

Title	*Publication or Drawing No.*	*Tab No.*
Instructions — Metal-Clad Switchgear, 15 KV Power Circuit Breakers, Type 15HK1000	IB-8.2.7-3	6
Instructions — Metal-Clad Switchgear, 7.5 and 15 KV Power Circuit Breakers	IB-8.2.7-4	6
Instructions — Switchgear Components, Type L2 Auxiliary Switches	IB-15.3.5.7-1	6
Renewal Parts — 15 KV Power Circuit Breakers, Type 15HK1000	RP-8.2.8-12	6
Renewal Parts — 15 KV Power Circuit Breakers, Type 15HK750	RP-8.2.8-10	6
Connection Diagram — Start Breaker Cubicle	370C837	7
Connection Diagram — Run Breaker and Auxiliary Cubicles	361D546	7
Service Manual—Exide Constant Voltage Float Charger-Model US	58.25	8
Instructions for Installing and Operating Exide Constant Voltage Float Charger-Model US	58.20	8
Instruction Manual—Sychro-Pac Brushless Synchronous Motors	1100-INS-159	9
Renewal Parts — Rotating Apparatus	SH-186	9
E.M. Renewal Parts Ordering Information	10-1	9

Title	Publication or Drawing No.	Tab No.
Instruction Manual — Ideal Electric Squirrel Cage and Wound Rotor Induction Motors	IM-500	10
Installation Instructions — Fenwal Series 40-102, 40-103, 40-104, 40-230, and 40-231 Indicating Temperature Controllers	2.20E	10

RENEWAL PARTS

Quotation No. SLS- 7539

ELECTORQUE ASSOC. INC.

WORLD TRADE CENTER
WOODSIDE, NEW YORK

REQ'N. 300-92819

Renewal Parts which we recommend that purchaser carry in stock for normal maintenance or for emergency conditions, for the switchgear equipment furnished on this requisition, are listed on the following pages.

It is estimated that shipment can be made in approximately 24 weeks after the receipt of an order, with complete information.

Quoted prices of breaker elements are List (Go-225 applies).
Quoted prices of other complete devices are Net.
Quoted prices of recommended spare parts are List (GO-46R applies).

Quoted prices are prepared for domestic delivery, f.o.b., point of shipment, with the transportation charges prepaid (allowed).

It is recommended that quantities supplied be determined by ordering one of each item for each 10 devices of that item as shown below.

INDEX

ITEM	QUANTITY	CATALOG NUMBER	DESCRIPTION	LIST EACH GO-225
1	8	733-224A5988-1	AM-13.8-1000-3H, 1200 Amp Breaker Element	$14,115.00
2	7	721-10AA008	SBM Control Switch	25.50
3	7	10AA125	SBM Control Switch	20.50
4	7	10AX002 G-3	SBM Auxiliary Switch	
5	7	12IAC51B2A	IAC Relay	132.00
6	21	12IAC51B101A	IAC Relay	132.00
7	21	116B6708 G-2	ET-16 Indicating Lamp	

SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

ANDERSON, IN

E.A.Roth 10-24-70

MVS

GENERAL ELECTRIC COMPANY

Quotation No. SLS-7539

RENEWAL PARTS RECOMMENDATIONS

Catalog Number	Description	Quantity Per Device	List Price Each
	ITEM 1		
	RECOMMENDED BREAKER RENEWAL PARTS FOR THE TYPE AM-13.8-1000-3H MAGNE-BLAST BREAKER, 1200 AMPERE WITH STORED-ENERGY MECHANISM:		
FOR BREAKER:			
733-281B708 G-7	Operating rod assembly	3	$ 11.50
966C354 G-2	Stationary arcing contact assembly	3	110.00
966C351 G-3	Flexible connection (left)	3	.55
966C351 G-4	Flexible connection (right)	3	.55
966C352 P-7	Insulating plate	3	5.30
6445087 P-4	Buffer	3	1.40
6557243 P-2	Buffer clamp	6	.40
966C352 P-10	Lower runner insulation (left)	3	12.50
966C352 P-9	Lower runner insulation (right)	3	12.50
105C9396 G-2	Arc chute throat (left)	3	73.00
105C9396 G-1	Arc chute throat (right)	3	73.00
414A180 P-1	Primary contact finger spring	24	.65
114C5382 P-2	Primary contact finger	24	7.60
966C353 G-1	Movable arcing contact	3	38.00
688C595 P-22	Movable primary contact (outside, left)	3	13.50
688C595 P-21	Movable primary contact (outside, right)	3	13.50
6591644 P-7	Movable primary contact (inside, left)	3	13.50
6591644 P-8	Movable primary contact (inside, right)	3	13.50
FOR MECHANISM:			
105C9393 P-1	Motor	1	161.00
137A7575 P-4	Relay	1	20.50
6275C70 G-2	Release & trip coil	2	42.50
456A866 P-5	Switch, normally open	5	4.80
456A866 P-6	Switch, normally closed	1	4.80
10AX006 G-4	Auxiliary switch	1	40.00
161A4231	Closing latch spring	1	.40
137A5252	Prop spring	1	1.80
161A5909	Pawl spring	3	1.80
	BULLETIN GEI-88766		
733-685C810 G-3	Spare breaker elevating motor	1	325.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

RENEWAL PARTS RECOMMENDATIONS

Catalog Number	Description	Quantity Per Device	List Price Each
	ITEM 2		
	MODEL 721-10AA008		
	TYPE SBM CONTROL SWITCH:		
721-127A6770 G-1	Moving contact assembly	6	$ 1.80
127A6749 G-1	Stationary contact, upper	6	1.10
127A6751 G-1	Stationary contact, lower	6	1.10
165A6178	Detent spring	1	.20
	BULLETIN GEF-4167		
	ITEM 3		
	MODEL 721-10AA125		
	TYPE SBM CONTROL SWITCH:		
721-127A6770 G-1	Moving contact assembly	2	1.80
127A6749 G-1	Stationary contact, upper	2	1.10
127A6751 G-1	Stationary contact, lower	2	1.10
127A6775 P-1	Torsion spring	1	1.40
	BULLETIN GEF-4167		
	ITEM 4		
	MODEL 721-10AX002 G-3		
	TYPE SBM AUXILIARY SWITCH:		
721-127A6770 G-1	Moving contact assembly	6	1.80
127A6749 G-1	Stationary contact, upper	6	1.10
127A6751 G-1	Stationary contact, lower	6	1.10
	BULLETIN GEF-4167		
	ITEM 5		
	MODEL 721-12IAC51B2A		
	TYPE IAC RELAY:		
721-891B45) G-22	Operating coil assembly	1	40.50
615853(G-1	Moving contact & spring assembly	1	12.00
620943) G-1	Stationary contact	1	.55
629320) G-3	Seal-in unit	1	24.50
629320' G-19	Instantaneous unit	1	38.00
	BULLETIN GEF-3883		

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

GENERAL ELECTRIC COMPANY

Quotation No. SLS- 7539

RENEWAL PARTS RECOMMENDATIONS

Catalog Number	Description	Quantity Per Device	List Price Each
	ITEM 6 MODEL 721-12IAC51B101A TYPE IAC RELAY:		
721-8918450 G-1	Operating coil assembly	1	$ 40.50
6158531 G-1	Moving contact & spring assembly	1	12.00
6209430 G-1	Stationary contact	1	.55
6293203 G-3	Seal-in unit	1	24.50
6293204 G-19	Instantaneous unit	1	38.00
	BULLETIN GEF-3883		
	ITEM 7 MODEL 721-116B6708 G-2 TYPE ET-16 INDICATING LAMP:		
721-116B6708 G-2	Spare Indicating Lamp, complete with *color cap *specify color desired	1	6.60
1835	Spare Indicating Lamp Bulb	1	.40
	BULLETIN GEF-4326		

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

INSTRUCTIONS AND
RECOMMENDED PARTS
FOR MAINTENANCE

GEH-1802V
Supersedes
GEH-1802U & GEF-3837

METAL-CLAD SWITCHGEAR

Types M26 and M36

FOR MAGNE-BLAST AIR CIRCUIT BREAKER

TYPES AM-4.16 AND AM-13.8

SWITCHGEAR PRODUCTS DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

LIST OF ILLUSTRATIONS

PAGE

Fig. 1	Typical Indoor Metal-clad Switchgear Equipment	4
Fig. 2	Typical Outdoor Metal-clad Switchgear Equipment - Front View	4
Fig. 3	Typical Outdoor Metal-clad Switchgear Equipment With Protected Aisle - Side View	4
Fig. 4	Magne Blast Breaker	5
Fig. 5	Magne Blast Breaker	5
Fig. 6	Magne Blast Breaker	5
Fig. 7	Installation Details for Indoor Metal-clad Switchgear	6
Fig. 8	Installation Details for Outdoor Metal-clad Switchgear	8
Fig. 9	Installation Details for Outdoor Metal-clad Switchgear With Protected Aisle	10
Fig. 10	Metal-clad Switchgear	11
Fig. 11	Measurement of Adjustment of Primary Disconnecting Devices	12
Fig. 12	Potential Transformer Rollout Shown in Withdrawn Position	12
Fig. 13	Dummy Removable Element	13
Fig. 14	Ground and Test Device	13
Fig. 15	Padlocking Arrangement, Key Interlocking and Bus Boot Assembly	14
Fig. 16	Control Power Transformer Rollout Shown in Open Position	15
Fig. 17	Outdoor Metal-clad Switchgear - Addition of Units to Line-up	16
Fig. 18	Outdoor Metal-clad Switchgear With Protected Aisle	17
Fig. 19	Outdoor Transition Compartment	18
Fig. 20	Outdoor Transition Compartment	18
Fig. 22	Inspection Box for 13.8 KV Metal-clad Switchgear	19
Fig. 23	Bolt Torque Values	20
Fig. 23A	Bus Duct Gaskets	20
Fig. 24	Method of Making Bus Bar Connections	21
Fig. 25	13.8 KV Taped Joints	21
Fig. 25A	4.16 & 13.8 Bus Insulating Boot	21
Fig. 25B	Taping Roof Entrance Bushing	23
Fig. 26	Insulation of Connection Bars	23
Fig. 27	Rear View of Unit Showing Through-Type Current Transformers	24
Fig. 28	Termination Without Pothead Single-Conductor	24
Fig. 29	Termination Without Pothead Multi-Conductor	25
Fig. 29A	Positive Interlock Adjustments	29

Renewal Parts

Fig. 30A	View Showing Elevating Mechanism Motor and Control Unit	30
Fig. 30	Elevating Mechanism for M-26 Equipments Rated 250 MVA and M-36 Equipments Rated 1200A 500 mva	31
Fig. 31	Elevating Mechanism for M-36H Equipments Rated 750 mva M-26H Equipments Rated 350 mva M-36 Equipments Rated 200A	31
Fig. 31A	Elevating Mechanism for M-36HH Equipments Rated 1000mva	32
Fig. 32	Angle Bracket and Chain Drive	33
Fig. 33	Shutter Mechanism Assembly M-26	33
Fig. 34	Shutter Mechanism Assembly M-36	33
Fig. 35	Bus Support	34
Fig. 36	Molded Bus Support	34
Fig. 37	Bus Connection Boot (4.16 and 13.8KV)	34
Fig. 38	Door Handles and Locks	35
Fig. 39	Wiring Devices and Miscellaneous Parts	35
Fig. 40	Fuse Rollout Unit	35
Fig. 41	Potential Transformer Rollout Unit	36
Fig. 42	Control Power Transformer Rollout Unit	36
Fig. 43	Single and Triple-Conductor Potheads	36

123 pages

WORLD TRADE CENTER

Instruction Manual No.5

Operation and Maintenance of

HIGH VOLTAGE DISTRIBUTION SYSTEM

Final Edition
Engineering Department
Publication, May 1978

THE PORT AUTHORITY OF NY & NJ

WORLD TRADE CENTER

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Operation and Maintenance of

HIGH VOLTAGE DISTRIBUTION SYSTEM

Final Edition
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Publication, May 1978

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to Port Authority personnel who operate and maintain the High Voltage Distribution System of the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

The information and diagrams provided in this manual reflect the status of the equipment and circuitry as it existed upon the completion of research for the manual.

World Trade Center personnel should request revisions to this manual for all changes to equipment and circuitry that have occurred since that time.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Substation Designations	1-2
	Feeder Designations	1-3
	Notes on Appendices	1-4
2	DISTRIBUTION SYSTEM	
	Scope	2-1
	General	2-1
	Primary Distribution Center	2-2
	Substations	2-2
3	PRIMARY DISTRIBUTION CENTER	
	Scope	3-1
	Switchgear	3-1
	Air Circuit Breakers	3-6
	120V DC Supply	3-10
	Emergency Trip Circuit	3-11
	Heat Detectors	3-12
	Signals to Honeywell Computer	3-12
	Metering	3-12
4	SUBSTATIONS	
	Scope	4-1
	General	4-1
	Federal Pacific Primary Disconnect Switch	4-2
	Federal Pacific Network Transformer	4-8
	Federal Pacific Hottest Spot Indicator	4-11
	Westinghouse Primary Disconnect Switch	4-12
	Westinghouse Network Transformer	4-15
	Westinghouse Hottest Spot Indicator	4-16

CONTENTS

APPENDIX A ..... Abbreviations For Text

APPENDIX B ..... Electrical Symbols

APPENDIX C ..... Abbreviations For Drawings

APPENDIX D ..... Special Legend

APPENDIX E ..... World Trade Center - Floor Level Inter-Designations

ILLUSTRATIONS

Figure		Follows Page
2-1	Feeder Diagram Sublevel Substations, Refrigeration Plant and PDC	2-2
2-2	Feeder Diagram Tower Substations	2-2
2-3	Plan View Primary Distribution Center	2-2
2-4	Part Plan Substation 7 North	2-3
2-5	Part Plan Substation 7 South	2-3
2-6	Part Plan Substation 41 North	2-3
2-7	Part Plan Substation 41 South	2-3
2-8	Part Plan Substation 294A	2-3
2-9	Part Plan Substation 294B	2-3
2-10	Part Plan Northeast Plaza Substation	2-3
2-11	Part Plan Southeast Plaza Substation	2-3
2-12	Part Plan Customhouse Substation	2-3
3-1	Typical PDC Group	3-3
3-2	Typical Con Ed Feeder Cubicle Showing Side Terminal Strips	3-3

ILLUSTRATIONS

Figure		Follows Page
3-3	Typical Con Ed Feeder Cubicle Showing Top Terminal Strips	3-3
3-4	Schematic Typical Con Ed Feeder Circuit Breaker Control Circuit	3-3
3-5	Schematic and Development Typical Ammeter Selector Switch	3-3
3-5A	Schematic - Auxiliary Relays Terminal Strip Cabinet No. 145	3-4
3-5B	Schematic Typical Computer Alarm Circuit	3-4
3-6	Typical A,B,P, and R Feeder Cubicle	3-4
3-7	Schematic Typical Feeder A,B,P, and R Circuit Breaker Control Circuit	3-4
3-7A	Kirk Locks - Feeders A,B, and P	3-5
3-8	Typical Spare Feeder Cubicle Showing Top Terminal Strip	3-6
3-9	Typical Spare Feeder Cubicle Showing Side Terminal Strip	3-6
3-10	Schematic Typical Spare Feeder Cubicle	3-6
3-11	Wiring Diagram Typical Spare Feeder Cubicle	3-6
3-12	Typical 150-DH-1000 Circuit Breaker Front View	3-7
3-13	Typical 150-DH-1000 Circuit Breaker Rear View	3-7

ILLUSTRATIONS

Figure		Follows Page
3-14	120V DC Supply	3-10
3-15	Schematic 120V DC Supply	3-10
3-16	Wiring Diagram Terminal Strip Cabinet No. 145	3-12
3-16A	Circuit Schedule Terminal Strip Cabinet	3-12
3-17	Typical PDC Group Watthour Meters	3-13
3-18	Totalizers and Demand Meters	3-13
3-19	Tower A Totalizers and Demand Meter	3-14
3-20	Refrigeration Plant Totalizers and Demand Meter	3-14
3-21	Con Ed Feeders Totalizers and Demand Meter	3-14
3-22	Wiring Diagram Typical PDC Group Watthour Meters	3-14
3-23	Wiring Diagram Tower A or B Totalizers and Demand Meter	3-14
3-24	Wiring Diagram Refrigeration Plant Totalizers and Demand Meter	3-14
3-25	Wiring Diagram Con Ed Feeders Totalizers	3-14
4-1	Typical Federal Pacific High Voltage Switchgear	4-1
4-2	Typical Westinghouse High Voltage Switchgear	4-2

ILLUSTRATIONS

Figure		Follows Page
4-3	One-Line Diagram Typical High Voltage Switchgear	4-2
4-4	Typical Federal Pacific Primary Disconnect Switch Interior View, Closed Position	4-3
4-5	Operating Handle - Typical Federal Pacific Primary Disconnect Switch	4-3
4-6	Electrical Work Permit (PA Form 2497)	4-4
4-7	Typical Federal Pacific Network Transformer - Interior View	4-8
4-7A	Cooling Fans Federal Pacific Transformers	4-10
4-8	Wiring Diagram Typical Hottest Spot Indicator Federal Pacific Transformers	4-10
4-9	Typical Hottest Spot Indicator Federal Pacific Transformers	4-11
4-10	Operating Handle - Typical Westinghouse Primary Disconnect Switch	4-12
4-11	Typical Westinghouse Primary Disconnect Switch Interior View, Open Position	4-12
4-12	Wiring Diagram Typical Hottest Spot Indicator Westinghouse Transformers	4-16

CHAPTER 1

INTRODUCTION

SCOPE

The topic of this manual is the High Voltage Distribution System of the World Trade Center. Chapter 1 is an introduction to the manual. It contains an explanation of the designation system used in the Center and an account of the appendices that are presented in the rear of the manual. Chapter 2 focuses on the distribution system as a whole. It includes a one-line cable diagram of the system and layout plans of its Primary Distribution Center and substations.

Chapter 3 deals with the Primary Distribution Center. It contains descriptions of the air circuit breakers (ACB's), their cubicles, and the metering system. Also included are detailed explanations of: the Emergency Trip Circuit; the 120V dc Supply; and signals to the Honeywell Computer. Chapter 4 is concerned with the substations of the High Voltage Distribution System. It includes descriptions of: the primary disconnect and grounding switches and their operating procedures; the network transformers; and their hottest spot indicators.

GENERAL

Installed transformer capacity in the Trade Center, which includes a large margin for future growth, has a total rating of 135,000 KVA. This capacity is distributed among 90 network transformers rated at 1500 KVA each. Their locations within the substations are shown on partial plan layouts in Chapter 2,

165 pages

WORLD TRADE CENTER

Instruction Manual No. 6

Operation and Maintenance of

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Final Edition
Engineering Department
Publication, August 1982

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WORLD TRADE CENTER

Instruction Manual No. 6

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEMS TOWERS A & B

Final Edition
Engineering Department
Publication, August 1982

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented to aid Port Authority personnel who operate and maintain the Electrical Systems at the World Trade Center.

This manual should be used, with, and must comply with, instructions in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been compiled, researched, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-2
	Primary Distribution Center	1-2
	Substations	1-3
	Feeder Designations	1-3
	Electrical Equipment	1-4
	Distribution System	1-5
	Safety	1-6
	Notes On Text, Diagrams, And Photos	1-6
	Notes On Appendices	1-6
2	HIGH VOLTAGE SWITCHGEAR CABINETS	
	Scope	2-1
	General	2-1
	Primary Disconnect And Grounding Switch	2-2
	Network Transformer	2-2
	Network Protector	2-5
	Alarm System	2-8
3	DISTRIBUTION SWITCHBOARDS	
	Scope	3-1
	General	3-1
	Current Monitor Components	3-3
	Ground Fault Protection	3-3
	Main Service Protectors	3-4
	Branch Service Protectors	3-7
	Fused Disconnect Switches	3-7
	Load Distribution	3-8

CONTENTS

Chapter		Page
4	MOTOR CONTROL CENTERS	
	Scope	4-1
	General	4-1
5	DISTRIBUTION PANELS	
	Scope	5-1
	Lighting Control System	5-1
	Lighting And Receptacle Panels	5-2
	Power Metering	5-4
	Elevator Distribution Panels	5-4
	Emergency Distribution Panels	5-5
	107th Floor Restaurant Power Distribution	5-6
6	MAINTENANCE	
	Scope	6-1
	General	6-1
	Maintenance Schedules	6-3
7	TOWER B	
	Scope	7-1
	Substations	7-1
	Primary Feeders	7-2
	Substation Switchgear	7-2
	Computer Alarm System	7-2
	Substation Switchboards	7-2
	Main Load Distribution	7-3
	Switchboards LVET-1 And LVWT-1	7-6
	300 KVA Transformers	7-7
	Motor Control Centers	7-7

CONTENTS

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations For Text And Drawings

APPENDIX C ..... Electrical Symbols

APPENDIX D ..... Cross-Reference Of Fuse Types

CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the Low Voltage Power Distribution Systems of Towers A and B.

Chapter 1 provides a general view of the High and Low Voltage Power Distribution Systems installed in both towers.

Chapter 2 deals with the High Voltage Switchgear Cabinets in the substations and the alarm system related to them.

Chapter 3 focuses on the Distribution Switchboards of the system. The subject matter includes the Main Distribution Switchboards that were installed in the towers at the time of construction and the subdistribution switchboards that were installed on the 109th floor of Tower A at a later date.

Chapter 4 describes the Motor Control Centers in the towers. Included in the chapter is a listing of the manufacturer's shop drawings of the Motor Control Centers and the controllers housed in the centers.

Chapter 5 provides information on the subdistribution panels and power metering equipment in the towers.

Chapter 6 serves as a guide to maintenance personnel charged with the responsibility for maintaining the electrical equipment in the towers.

Chapter 7 concerns the Low Voltage Distribution System in Tower B. Contained in the chapter are descriptions of the differences between the systems in Towers A and B.

GENERAL

Electric power for the World Trade Center is purchased from the Power Authority of the State of New York (PASNY), and delivered by Consolidated Edison (Con Ed) via a substation located north of the Trade Center on Vesey Street. Power from the Con Ed substation is conducted underground at 13.8 KV via cables, 2 in parallel for each of the 8 incoming feeders, to a Primary Distribution Center (PDC).

The PDC is on Level B3 (Elevation 274') in the extreme northeast corner of the World Trade Center. The PDC receives the 8 Con Ed feeders and subdivides them into 3 groups of 8 secondary, 13.8 KV feeders and 1 group of seven 13.8 KV feeders. One group of feeders feeds the 8 abovegrade substations in Tower A. See Figure 1-1. The second group feeds the 8 substations in Tower B.

The third group of 8 feeders serves the substations in the sublevels of the towers and the Northeast and Southeast Plaza Buildings. The group of 7 feeders feeds the Central Refrigeration Plant.

For a comprehensive description of the High Voltage Distribution System, refer to World Trade Center O&M Manual No. 5 "High Voltage Distribution System".

PRIMARY DISTRIBUTION CENTER

The PDC consists of 8 switchgear groups which are designated PDC No.1 (PDC-1) thru PDC No.8 (PDC-8). Each switchgear group contains 6 cubicles, of which at least 1 is a spare. Each Con Ed incoming feeder feeds 1 switchgear group via an ACB in that group. Four secondary feeders from each group serve different parts of the WTC complex, as described in the "General" section above. For a complete description of the PDC refer to World Trade Center O&M Manual No.5 "High Voltage Distribution System".

Each cubicle in the PDC contains a draw-out ACB, rated at 1200A continuous current with an interrupting capacity of 1000

131 page

WORLD TRADE CENTER

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Operation and Maintenance of

EMERGENCY POWER DISTRIBUTION SYSTEM

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F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide Port Authority personnel who operate and maintain the Emergency Power Systems at the World Trade Center complex.

This manual should be used with, and must comply with, instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Equipment Location	1-2
	Notes On Appendices	1-2
2	ENGINE DESCRIPTION AND CONTROLS	
	Scope	2-1
	Engine Description	2-1
	Engine-Generator and Master Control Panels .	2-9
	Auxiliary Equipment	2-16
3	POWER GENERATORS AND CONTROLS	
	Scope	3-1
	Description	3-1
	Synchronizing Systems	3-4
	Protection System	3-17
	Metering Systems	3-18
	480V Air Circuit Breakers	3-19
4	EMERGENCY POWER DISTRIBUTION	
	Scope	4-1
	System Description	4-1
	Emergency Power Centers	4-2

CONTENTS

Chapter		Page
5	SOURCE TRANSFER SYSTEM	
	Scope	5-1
	Main Automatic Transfer Switches	5-1
	ATS Maintenance Schedule	5-10
	Source Distribution System	5-11
	Main Transfer Switch Control Panel	5-13
	Miscellaneous Automatic Transfer Switches .	5-16
6	POWER SYSTEM PROCEDURES	
	Scope	6-1
	System Operation	6-1
	Engine,Generator,ACB Indication Alarms . . .	6-17
	REFERENCES	
	Manufacturers' Literature	R1
	Vendors' Drawing Numbers	R2
	PA Drawing Numbers	R3
	APPENDIX A ..... Abbreviations For Text	
	APPENDIX B ..... Electrical Symbols	
	APPENDIX C ..... Abbreviations For Drawings	
	APPENDIX D ..... Special Legend	

ILLUSTRATIONS

Figure		Follows Page
1.1	Emergency Generator Room World Trade Center	1-2
2.1	Typical Diesel Engine-Generator Set	2-1
2.2	Typical Engine Starting Motor Emergency Generator Set	2-1
2.3	Typical Engine-Generator Accessories	2-2
2.4	Typical Engine-Generator Control Units . . .	2-3
2.5	Auxiliary Equipment Emergency Generator System	2-5
2.6	Diesel Engine Gage Panel Emergency Generator Set	2-7
2.7	Pressure and Temperature Gages Diesel Engine Gage Panel	2-7
2.8	Master Control Panel and Engine-Generator Control Panel	2-10
2.9	Diesel Engine,Generator, and ACB Control Panels	2-10
2.10	Typical Engine-Generator Control Panel Emergency Generator Room	2-10
2.11	Master Control Panel Emergency Generator Room	2-10
2.12	Engine Control Circuit Emergency Generator System	2-13
2.13	Typical Engine-Generator Control Relays . .	2-14
2.14	Battery Cabinet and Battery Charger Panel	2-16
3.1	Brushless Rotating Exciter and Voltage Regulator	3-2

ILLUSTRATIONS

Figure		Follows Page
3.2	Control Relays and Equipment Inside Typical Engine-Generator Control Panel	3-4
3.3	Control Relays Master Control Panel	3-5
3.4	Control Relays and Equipment Inside Master Control Panel	3-6
3.5	Generator Synchronizing and Priority Circuits Emergency-Generator System	3-7
3.6	Priority Switch Cabinet Master Control Panel	3-15
3.7	Priority Switch Mechanism Master Control Panel	3-16
3.8	Typical Generator ACB Engine-Generator Control Panel	3-19
3.9	Left Main Distribution Board Emergency Generator Loads, North Tower	3-19
3.10	Right Main Distribution Board Emergency Generator Loads, South Tower	3-19
3.11	Generator ACB Typical Trip and Close Circuits	3-20
3.12	One Line Diagram Emergency Power System World Trade Center	3-22
3.13	Main Distribution ACB Typical Trip & Close Circuits	3-23
4.1	ATS's G1,G2,G3 and Emergency Panels Emergency Generator Room	4-1

ILLUSTRATIONS

Figure		Follows Page
4.2	Schematic Layout Emergency Panels and Automatic Transfer Switches	4-2
4.3A	Emergency Panel Schedule Emergency Generator Room	4-2
4.3B	Emergency Panel Schedule Emergency Generator Room	4-2
4.4	Lighting and Elevator Loads Emergency Power Centers (EPC) North Tower	4-3
4.5	Lighting and Elevator Loads Emergency Power Centers (EPC) South Tower	4-3
4.6	Emergency Power Centers (EPC) N.E. and S.E. Plaza Buildings and U.S. Customhouse	4-3
4.7	Emergency Power Centers (EPC) Below Grade Levels - North Tower	4-3
4.8	Emergency Power Centers (EPC) Below Grade Levels - South Tower	4-3
4.9	Emergency Power Center (EPC) - 7A Electrical Closet 7th Floor MER North Tower	4-5
4.10	Shuttle Elevator ATS-41NL Separately Mounted In Cabinet	4-5
4.11	ACB and Switch Schedule - North Tower Emergency Power Centers	4-5
4.12	ACB and Switch Schedule - South Tower Emergency Power Centers	4-5

ILLUSTRATIONS

Figure		Follows Page
4.13	ACB Schedule N.E. and S.E. Plaza Buildings Emergency Power Centers	4-5
4.14	ATS Schedule North Tower	4-5
4.15	ATS Schedule South Tower	4-5
4.16	ATS Schedule N.E. and S.E. Plaza Buildings	4-5
4.17	ATS Description North Tower	4-5
4.18	ATS Description South Tower	4-5
4.19	Transfer Switch Schedule North Tower	4-5
4.20	Transfer Switch Schedule South Tower	4-5
4.21	ATS Arrangement Diagram Lighting and Elevator Loads	4-6
5.1	3-Source Lighting ATS Emergency Power Center 7A	5-1
5.2	Fire Pump ATS Subgrade Level B1, North Tower	5-1
5.3	Jockey and Sprinkler Pump ATS Subgrade Level B1, North Tower	5-1
5.4	Automatic Transfer Switches North Tower	5-2
5.5	Automatic Transfer Switches South Tower	5-2

ILLUSTRATIONS

Figure		Follows Page
5.6	Lighting Loads - EPC 41A Normal and Emergency Feeds North Tower	5-2
5.7	ATS Control Circuit 3-Source Lighting System	5-2
5.8	Miscellaneous Pump Loads Normal and Emergency Feeds North Tower	5-4
5.9	ATS Control Circuit 3-Source Fire Department Elevator System . .	5-4
5.10	Elevator Loads - Substation 41N Normal and Emergency Feeds North Tower	5-5
5.11	ATS Control Circuit Bank and Shuttle Elevator System	5-5
5.12	ATS Control Circuit Fire Pump Station	5-7
5.13	Visual Indications and Transfer Controls Fire Pump ATS	5-9
5.14	Fire Pump Control Station 41st Floor MER, North Tower	5-9
5.15	ATS Control Circuit Jockey and Sprinkler Pump Station	5-9
5.16	Lighting Panel ERPC - Interior 7th Floor MER, EPC 7A	5-11
5.17	480V Substation Switchboard - SS41N Split Bus Section	5-11
5.18	Elevator Distribution Panel 41st Floor MER, North Tower	5-12

ILLUSTRATIONS

Figure		Follows Page
5.19	Main Transfer Switch Control Panel Emergency Generator Room	5-13
5.20	Main Transfer Switch Control Panel North Tower	5-13
5.21	Main Transfer Switch Control Panel South Tower	5-14
5.22	ATS's G1,G2,G3 Panels Emergency Generator Room	5-17
5.23	Inside ATS G3 Panel Emergency Generator Room	5-17
5.24	ATS G1 and G2 Control Circuit 3-Source Load System	5-17
5.25	ATS G3 Control Circuit 2-Source Load System	5-17
6.1	Typical Load and Speed Sensing Unit Engine-Generator Control Panel	6-14
6.2	Typical One Phase Circuit Load and Speed Sensing Unit	6-14

CHAPTER 1

INTRODUCTION

SCOPE

This manual describes the electrical equipment and systems of the emergency power in use at the World Trade Center (WTC) complex, excluding the Hotel.

Chapter 1 discusses the need for emergency power, the location of equipment, and the appendices.

Chapter 2 describes the diesel engines, their controls, protection, and associated auxiliary equipment.

Chapter 3 describes the electrical generator, its control and protection, and the synchronization system. The chapter concludes with a description of the generator and main ACB's.

Chapter 4 discusses the Emergency Power Center (EPC) as part of the Emergency Power Distribution System.

Chapter 5 describes the automatic transfer switches (ATS's) in the system as well as the Main Transfer Switch Control Panel.

Chapter 6 discusses the operating procedures of the system, viz, the starting and stopping of the emergency generators. In this chapter the system of load sharing among the generators is also described. The chapter concludes with a discussion of the indicating alarm (both visual and audible) systems in use.

GENERAL

The World Trade Center complex is provided with emergency power to operate the emergency lighting loads, elevator

loads, and fire fighting equipment (including the Fire Department Elevators) so that everyone can be evacuated from the buildings in the event of a utility power failure. Emergency power is not designed to replace total utility power for the day-to-day operations of the WTC complex.

The emergency lighting loads include the stairway and exit lights, corridor lighting, and other essential areas of the complex.

The emergency generator will start automatically only when power to the emergency lighting panels fails.

EQUIPMENT LOCATION

There are five 1000 KW generators located in Level B6, alongside stairway K-1A. See Figure 1.1. The diesel engine generators, together with their battery set, are installed adjacent to one another in the Emergency Generator Room. Located in this same room are the Engine-Generator Control Panels, the Master Control Panel, and the Main Distribution Boards. Behind these panels are located the Emergency Switchboards (ESB). The automatic transfer switches of this power system are located on various floors of the Towers, as well as in the other buildings and the subgrade levels of the complex.

NOTES ON APPENDICES

In this manual the Abbreviations For Text will be found in Appendix A, the Electrical Symbols in Appendix B, the Abbreviations For Drawings in Appendix C, and the Special Legend in Appendix D. This legend is a general list of the abbreviations and letter symbols used for this power system.

WTCI-5-P

121 pages

WORLD TRADE CENTER

Instruction Manual No. 9

Operation and Maintenance of

PLAZA SCULPTURE FOUNTAIN SYSTEM

Final Edition
Engineering Department
Publication, March 1980

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented to aid Port Authority personnel who operate and maintain the Plaza Sculpture Fountain at the World Trade Center.

This manual should be used with, and must comply with, instructions in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been compiled, researched, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General Description	1-1
	Sculpture Fountain Water Flow	1-3
	Power Distribution	1-4
	Notes On Appendices	1-5
2	MAJOR COMPONENTS	
	Sculpture Fountain Pumps	2-1
	Automatic Strainer	2-2
	Storage Tank	2-3
	Make-up Water Transfer Pumps	2-3
	Balance Tank Level Control Components	2-4
	Early Warning Alarm Panel	2-5
3	MECHANICAL AND ELECTRICAL SYSTEMS	
	Supply Pump Control	3-1
	Controlled Air Supply	3-2
	Automatic Strainer Control	3-3
	Storage Tank Fill Controls	3-4
	Balance Tank Level Control System	3-5
	Early Warning Alarm System	3-7
	Pool Water Circulation	3-8
	Drain Valves Winter Switch	3-10
4	FILTER SYSTEM	
	General Description And Introduction	4-1
	Components	4-2
	Influent Control System	4-7
	Chemical Feed System	4-8
	Filter Control Circuits	4-11

CONTENTS

Chapter		Page
5	WATER FLOW SYSTEM OPERATION	
	Scope	5-1
	Water Flow System	5-1
	Seasonal Start-Up	5-6
	Filter Precoating	5-10
	Placing Filter On Stream	5-12
	Short Term Shutdown And Start-Up	5-13
	Long Term Shutdown	5-13
6	MAINTENANCE	
	Introduction	6-1
	General	6-1
	Items Of Equipment	6-3

APPENDIX A ..... Abbreviations For Text

APPENDIX B ..... Electrical Symbols

APPENDIX C ..... Abbreviations For Drawings

APPANDIX D ..... Special Abbreviations For Drawings And Text

ILLUSTRATIONS

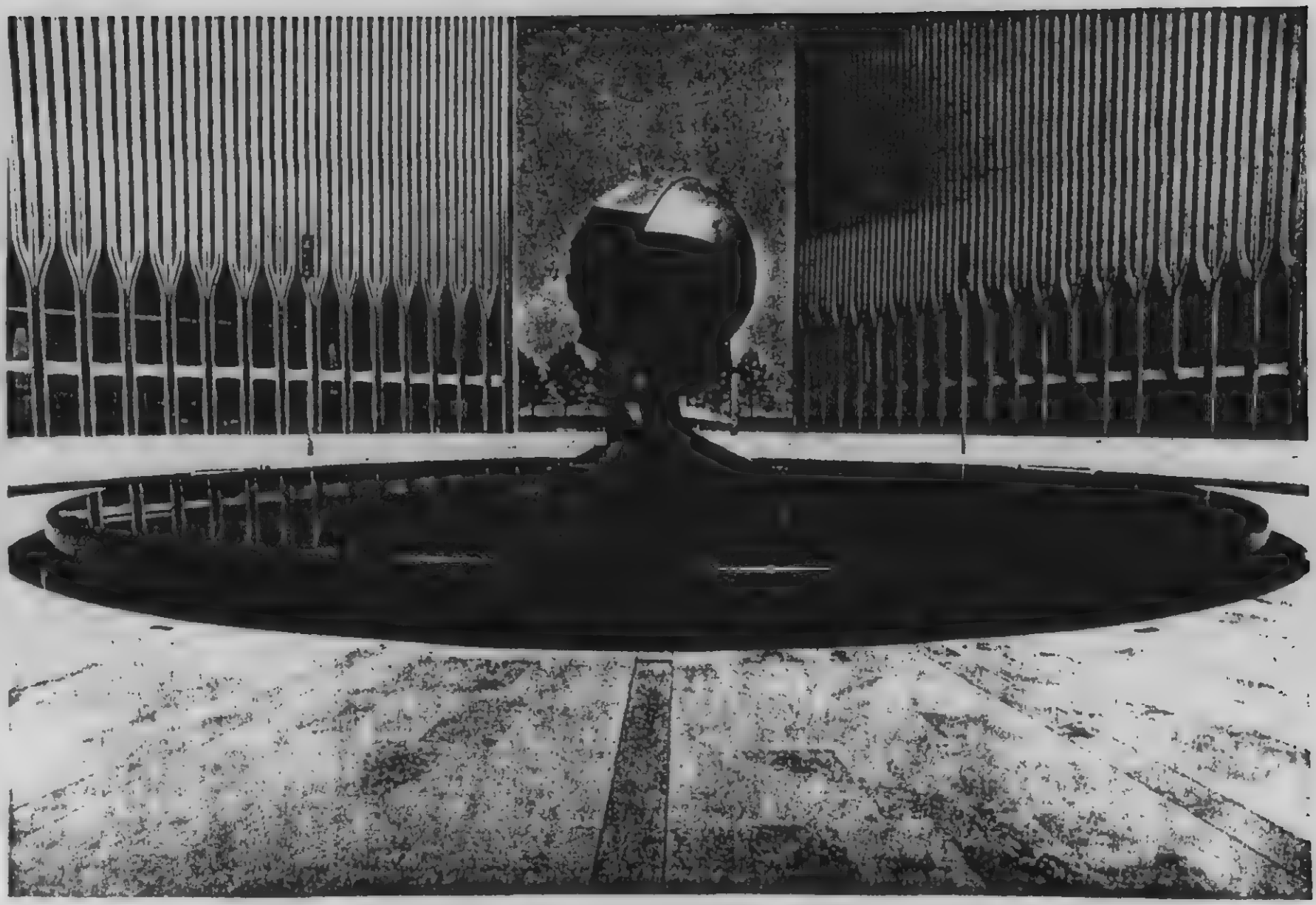
Figure		Follows Page
1-1	Flow Diagram Sculpture Fountain System	1-3
1-2	Equipment Layout Pool Equipment Room	1-3
1-3	Valve Tag Index	1-4
1-4	Motor Control Center and Power Distribution Panel	1-4
1-5	One Line Diagram Power Distribution	1-4
1-6	Low Voltage Distribution Panel	1-4
1-7	Wiring Diagram Sculpture Fountain System	1-4
2-1	Sculpture Fountain Pump	2-1
2-2	Air Operated Valve Discharge Line	2-2
2-3	Automatic Strainer	2-2
2-4	Control Panels - Early Warning Alarm, Balance Tank Level, and Automatic Strainer	2-3
2-5	Make-up Water Transfer Pumps	2-4
3-1	Motor Starter Open Cubicle Fountain Supply Pump	3-1
3-2	Schematic - Typical Starter and Safety Control Circuit - Fountain Supply Pump	3-1
3-3	Controlled Air Distribution	3-2
3-4	Schematic - Control Circuit Automatic Strainer	3-3
3-5	Water Level and Temperature Controls Storage Tank	3-4

ILLUSTRATIONS

Figure		Follows Page
3-6	Diagrams - Water Level and Temperature Controls Storage Tank	3-4
3-7	City Water Control Valves Storage Tank	3-4
3-8	Water Level Control Settings Sculpture Fountain System	3-6
3-9	Schematic - Control Circuit Balance Tank Water Level Controller	3-6
3-10	Typical Valves and Piping Fountain Supply Pumps	3-8
3-11	Main Throttling Valve Pool Supply Water Line	3-8
3-12	Flow Diagram Pool Water Circulation	3-9
3-13	Make-Up Water Line	3-9
4-1	Filter System Equipment	4-1
4-2	Filtration System Control Cabinet	4-2
4-3	Filter Influent Control and Vacuum Limit Switches	4-5
4-4	Filter Wash Components	4-6
4-5	Control Valves - Filtered Water Supply and Recycle Lines	4-6
4-6	Chemical Feeders and Filtrate Sampling Chamber	4-8
4-7	Flow Diagram Filter System.	4-10
4-8	Schematic - Control Circuits Filter System	4-11

ILLUSTRATIONS

Figure		Follows Page
4-9	Schematic - Alarm and Function Indicator Circuits - Filter System	4-11
5-1	Flow Diagram Trough Filling Circulation	5-8
5-2	Flow Diagram Header Filling Circulation	5-9
5-3	Flow Diagram Fountain Display Circulation	5-9



CHAPTER I

INTRODUCTION

SCOPE

The equipment, operation, and maintenance of the Sculpture Fountain System are discussed in this manual. This chapter is the general introduction to the system and includes a flow diagram, valve index, and the location of the mechanical and electrical components. Chapter 2 contains the descriptions of the major components in the system. The mechanical and electrical controls for the system are discussed in Chapter 3. The filter package is described in Chapter 4, which also includes a description of the filter system's control circuits and chemicals. A step-by-step operational procedure is presented in Chapter 5 and the maintenance recommendations are provided in Chapter 6.

GENERAL DESCRIPTION

The Sculpture Fountain System provides a filtered and chemically treated water stream, ejected from a continuous nozzle, which arcs close to the midpoint of the sculpture platform. The throw of water to the point of impact can be varied. The water is collected in the trough at the foot of the platform and recirculated by the Sculpture Fountain Pumps which are also referred to as the supply pumps. An automatic strainer separates accumulated solids from the returned pool water. There are four Sculpture Fountain Pumps located in the Pool Equipment Room (PER). Two running pumps are required to supply the discharge for the desired throw of water. The other two supply pumps are alternated into the operation.

224 pages

WORLD TRADE CENTER

Instruction Manual No. 10

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM NORTHEAST AND SOUTHEAST PLAZA BUILDINGS

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Publication, September 1984

THE PORT AUTHORITY OF NY & NJ

WORLD TRADE CENTER

Instruction Manual No. 10

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM NORTHEAST AND SOUTHEAST PLAZA BUILDINGS

Final Edition
Engineering Department
Publication, September 1984

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Low Voltage Distribution System of the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

PREFACE

This manual is written in two sections: the first section covers the Northeast Plaza Building and the second the Southeast Plaza Building.

Each section contains its own Table of Contents, List of Illustrations, and descriptive chapters.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-2
	Safety	1-2
	Notes On Text And Illustrations	1-2
	Notes On Appendices	1-3
2	DISTRIBUTION SYSTEM	
	Scope	2-1
	General	2-1
	Riser Diagram Discussion	2-2
	Distribution Panels	2-4
	Substation	2-7
3	SUBSTATION	
	Scope	3-1
	High Voltage Switchgear	3-1
	Main Distribution Switchboards	3-6
	Alarm System	3-14
	Emergency Transfer Switches	3-16
4	DISTRIBUTION PANELS	
	Scope	4-1
	General	4-1
	Controlled Circuits	4-2
	Local Control Of Circuits	4-3
	Panel Schedules	4-3

CONTENTS

Chapter		Page
5	MAINTENANCE AND TROUBLESHOOTING	
	Scope	5-1
	General	5-1
	Maintenance Schedules	5-4
	Troubleshooting	5-9
	APPENDIX ..... List Of Illustrations	

CHAPTER 1

INTRODUCTION

SCOPE

This manual is written in 2 sections: the first section provides information about the Low Voltage Distribution System in the Northeast Plaza Building (NEPB); the second section covers the Low Voltage Distribution System in the Southeast Plaza Building (SEPB).

Chapter 1 of this section of the manual is its Introduction. It describes the organization of the section and contains general information regarding the Low Voltage Distribution System in the NEPB.

Chapter 2 describes the distribution system of the NEPB.

Chapter 3 focuses on the Substation in the building, and includes information regarding the major components in the Substation.

Chapter 4 covers the distribution panels in the NEPB, and includes schedules of the panels.

Chapter 5 provides maintenance information and recommendations for the major electrical components in the system, and system troubleshooting procedures.

WORLD TRADE CENTER

Instruction Manual No. 11

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM SUBGRADE LEVELS

Final Edition
Engineering Department
Publication, October 1984

THE PORT AUTHORITY OF NY & NJ

WORLD TRADE CENTER

Instruction Manual No. 11

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM SUBGRADE LEVELS

Final Edition
Engineering Department
Publication, October 1984

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Low Voltage Distribution System of the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Notes On Appendices	1-3
2	DISTRIBUTION SYSTEM	
	Scope	2-1
	General	2-1
	Feeder Designations	2-4
	Panel Designations	2-5
3	SUBSTATIONS	
	Scope	3-1
	General	3-1
	High Voltage Switchgear	3-1
	Main Distribution Switchboards	3-2
	Load Centers	3-3
	Emergency Transfer Switches Substation 294A	3-3
	Computer Alarm Circuits	3-6
	Emergency Transfer Switches Substation 294B	3-7
4	DISTRIBUTION PANELS	
	Scope	4-1
	General	4-1
	Lighting Circuits And Panels	4-1

CONTENTS

Chapter		Page
5	MAINTENANCE AND TROUBLESHOOTING	
	Scope	5-1
	General	5-1
	Maintenance Schedules	5-4
	Troubleshooting	5-9
	APPENDIX A ..... List Of Illustrations	
	APPENDIX B ..... Abbreviations For Text And Drawings	
	APPENDIX C ..... Symbols	
	APPENDIX D ..... Cross-Reference Of Fuse Types	

CHAPTER 1

INTRODUCTION

SCOPE

The Low Voltage Electrical Distribution System in the 6 sublevels of the towers and Subgrades of the World Trade Center is the subject of this manual.

Chapter 1 is the Introduction to the manual and contains a general description of the Subgrade areas.

Chapter 2 describes the distribution system.

Chapter 3 deals with the substations in the distribution system and the major distribution equipment in the substations.

Chapter 4 is concerned with the special distribution panels in the system.

Chapter 5 contains the maintenance requirements, procedures, and troubleshooting required to keep the electrical equipment in good operating order.

GENERAL

The Subgrade levels of the World Trade Center comprise 6 floors of space in the Sublevels (basement) of the towers and 6 levels of space below grade in the areas adjacent to the towers. See Figure 1-1.

The area north, east, and west of Tower A on the Concourse Level is designated the J area; the area north, east, and south of Tower B is designated the K area. The same Subgrade and Sublevel area designations are repeated for 6 additional levels down to Level B6 (Elevation 242'). See Figure 1-2.

Each level of the Subgrades encompasses an area of approximately 45,000 square feet (including PATH's station and track areas):

Elevation 310' includes the western end of the Concourse, the area beneath the U.S. Customhouse, and the lobbies of Towers A and B. See Figure 1-1.

Level B1 (Elevation 294') includes: the truck docks for Towers A and B, the Hotel's parking area, the Security Control Room (Police Desk), INHILCO's commissary, and some janitorial service offices.

Level B2 (Elevation 284') comprises electrical, mechanical, and structural maintenance shops and offices, parking areas, and many elevator pits.

Level B3 (Elevation 274') consists mainly of parking and tenant storage areas.

Level B4 (Elevation 264') also is used mainly for parking and tenant storage.

Level B5 (Elevation 253') includes the Refrigeration Plant's operating level and additional tenant storage.

Level B6 (Elevation 242') houses 2 Mechanical Equipment Rooms (MERs), the Emergency Generator Plant, and additional tenant storage space.

Electrical power for the Subgrades is provided from 2 electrical substations, one in each tower. Because these substations are on Elevation 294' (Level B1), they are designated: Substation 294A in Tower A and 294B in Tower B.

NOTES ON APPENDICES

At the rear of this manual are Appendices A thru D.

Appendix A contains all the figures required to support the text in each chapter. These figures are numbered and presented in the order in which they are first referred to in each chapter.

Appendix B is an alphabetical listing of all the abbreviations in the text and drawings of this manual and their definitions.

Appendix C is a listing of all the symbols in the diagrams of the manual and their definitions.

Appendix D is a cross-reference of the fuse products of popular manufacturers. This cross-reference can be used by maintenance personnel to select an equivalent fuse when the exact replacement is not available.

78 pages

WORLD TRADE CENTER

Instruction Manual No. 12

Operation and Maintenance of

SMOKE DETECTION SYSTEM
OBSERVATION DECK, TOWER B

Final Edition
Engineering Department
Publication, August 1981

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Smoke Detection System, Observation Deck, Tower B, in the World Trade Center.

This manual should be used with, and must comply with, instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Power Supply	1-1
	Notes on Appendices	1-2
2	SMOKE DETECTION EQUIPMENT - FLOOR 107	
	General	2-1
	Ceiling Smoke Detectors	2-1
	Smoke Detector Supervision Units	2-3
	Door Holders	2-3
	Electrothermal Links	2-4
	Rollup Fire Doors	2-5
	Manual Fire Alarm Stations	2-5
	Alarm and Trouble Bells	2-6
	Smoke Detection Control Panel	2-7
3	SMOKE DETECTION EQUIPMENT - FLOOR 108	
	General	3-1
	Duct Smoke Detectors	3-1
	Smoke Detector Supervision Units	3-2
	Alarm and Trouble Bells	3-3
	Smoke Detection Control Panel	3-3
	Fan Controls	3-4
	Smoke Purge System	3-5

CONTENTS

Chapter		Page
4	SMOKE DETECTION EQUIPMENT - FLOOR 110	
	General	4-1
	Duct Smoke Detectors	4-1
	Smoke Detector Supervision Units	4-2
	Alarm and Trouble Bells	4-2
	Smoke Detection Control Panel	4-2
	Fan Controls	4-3
	Smoke Purge From Floor 110	4-3
5	SMOKE DETECTION SYSTEM OPERATION	
	Scope	5-1
	General	5-1
	Smoke Purge	5-2
	Smoke on Floor 107	5-2
	Response to Smoke on Floor 107	5-4
	Smoke on Floor 108	5-5
	Response to Smoke on Floor 108	5-7
	Smoke on Floor 110	5-9
	Response to Smoke on Floor 110	5-11
	Trouble Condition	5-13
	Response to Trouble Condition	5-14

CONTENTS

Chapter		Page
6	MAINTENANCE	
	Scope	6-1
	Note	6-1
	General	6-1
	Alarm Indications	6-1
	Fire Damper and Fire Door Bypass	6-2
	Control Panels	6-2
	Supervisory Circuits	6-2
	Manual Fire Alarm Stations	6-2
	Ceiling Smoke Detectors	6-3
	Duct Smoke Detectors	6-4

APPENDIX A ..... Illustrations

APPENDIX B ..... Abbreviations For Text And Illustrations

APPENDIX C1 ..... Diagrams - Smoke Detection Equipment - Floor 107

APPENDIX C2 ..... Diagrams - Smoke Detection Equipment - Floor 108

APPENDIX C3 ..... Diagrams - Smoke Detection Equipment - Floor 110

APPENDIX D ..... Instruction Manual (123-0002) Model NKT-24, Products of Combustion Detector Tester

CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the Smoke Detection System for the Observation Deck located on Floor 107, Tower B, World Trade Center. This manual is divided into 6 chapters.

Chapter 1 is an Introduction to the manual, gives information of a general nature, and deals with power source.

Chapter 2 describes the Smoke Detection Equipment on the 107th floor.

Chapter 3 describes the Smoke Detection Equipment on the 108th floor.

Chapter 4 describes the Smoke Detection Equipment on the 110th floor.

Chapter 5 describes the operation of the Smoke Detection System.

Chapter 6 presents recommendations related to the servicing and testing of the Smoke Detection Equipment.

GENERAL

The Observation Deck is located on Floor 107. The supply, return, and exhaust fans associated with the Observation Deck are located on Floor 108. A First Aid Room on Floor 110 is associated with the Observation Deck. Smoke Detection Equipment is located on 3 floors: 107, 108 and 110. There is a Smoke Detection Control Panel on each of the 3 floors.

POWER SUPPLY

The Smoke Detection Control Panels on Floors 107, 108, and

110 receive 120V A.C., 1Ø, 60 HZ power from circuits 4 and 6 of Panel ERPC-110B, in Closet C, Floor 110, Tower B.

NOTES ON APPENDICES

At the back of this manual are Appendices A, B, C, and D.

Appendix A contains all illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains Abbreviations For Text And Drawings.

Appendix C1 contains diagrams relating to the Smoke Detection Equipment on Floor 107.

Appendix C2 contains diagrams relating to the Smoke Detection Equipment on Floor 108.

Appendix C3 contains diagrams relating to the Smoke Detection Equipment on Floor 110.

Appendix D contains Instruction Manual (123-0002), Model NXT-24, *Products of Combustion Detector Tester.*

108 pages

WORLD TRADE CENTER

Instruction Manual No. 13

Operation and Maintenance of

HALON FIRE PROTECTION SYSTEM COMPUTER CENTER, WTC

Final Edition
Engineering Department
Publication, December 1981

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are provided as an aide and guide to all personnel who operate the Computer Center Halon Fire Protection System.

This manual should be used in conjunction with the standard, emergency fire procedures presently in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

P R E F A C E

To the end that the Computer Center Halon Fire Protection System be properly utilized, it is essential that all personnel concerned be familiar with its operation. This manual provides information and operating instructions so that proper system utilization may be accomplished.

Since the subject matter is vital to all Computer Center personnel, periodic review is strongly recommended.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Notes On Appendices	1-2
	Abbreviations	1-2
2	FIRE DETECTION SUBSYSTEM	
	Scope	2-1
	General	2-1
	Fire Detectors	2-4
	Local Halon Control Panels	2-4
	Master Graphic Annunciator Panel	2-6
	Main Fire Detection Control Cabinet	2-7
	Security And Fire Alarm Control Panel	2-10
	Power Supply	2-11
3	HALON EXTINGUISHING SUBSYSTEM	
	Scope	3-1
	General	3-1
	Operation	3-2
4	ALARM SUBSYSTEM	
	Scope	4-1
	General	4-1
	Operation	4-1

CONTENTS

Chapter		Page
5	SYSTEM OPERATION	
	Scope	5-1
	General	5-1
	Automatic Operation	5-2
	Semiautomatic Operation	5-5
	Manual Operation	5-6
6	OPERATING PROCEDURES	
	Scope	6-1
	General	6-1
	Automatic And Semiautomatic Operation	6-2
	Manual Operation	6-9
	Purging	6-11
	System Reset Procedures	6-14
7	MAINTENANCE AND TESTING	
	Scope	7-1
	General	7-1
	Fire Detection, Warning, And Activation Subsystems	7-1
	Halon Fire Extinguishing Subsystem	7-3
	APPENDIX . . . . . Illustrations	

CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the Fire Protection System installed in the 70th Floor Computer Center.

Chapter 1 is the Introduction to the manual and contains general information concerning the system and contents of the manual.

Chapter 2 deals with the Fire Detection Subsystem which is part of the integrated Fire Protection System.

Chapter 3 describes the Halon 1301 Extinguishing Subsystem which is also part of the integrated system.

Chapter 4 focuses on the Alarm Subsystem.

Chapter 5 is concerned with all the subsystems as they operate within the integrated Fire Protection System.

Chapter 6 provides the procedures the Floor Warden, Assistant Floor Warden, or their designees should follow to operate the system properly.

Chapter 7 supplies information regarding the maintenance and testing of all the subsystems of the Halon Fire Protection System.

GENERAL

Installed in the 70th Floor Computer Center is a fully automatic Halon Fire Protection System. In actuality, the Fire Protection System is a consolidation of 3 subsystems. They are: the Fire Detection Subsystem, the Alarm Subsystem, and the Halon 1301 Extinguishing Subsystem.

The function of the Halon Fire Protection System is preservation of the extremely expensive computers, equipment, and valuable disk packs and data tapes used in the Computer Center. The extinguishing agent used is Halon 1301 gas which will not damage the equipment. Detailed descriptions of the subsystems and their operation within the integrated Fire Protection System are provided in the chapters that follow.

NOTES ON APPENDICES

Appearing at the rear of this manual is an Appendix. It contains all the illustrations and photos that support the text of each chapter. They are numbered and presented in the sequence in which they are first referred to in the chapters.

ABBREVIATIONS

An alphabetical listing of the abbreviations used in the text and illustrations of this manual and their definitions is provided below:

Abbreviation	*Definition*
A.C.	Alternating Current
Asst.	Assistant
C.D.C.	Control Data Corporation
C.E.	Customer Engineer
DC	Direct Current
I.B.M.	International Business Machines
LHC	Local Halon Control
N.C.R.	National Cash Register
No.	Number
N.Y.C.	New York City
V	Volts

210 pages

WORLD TRADE CENTER

Instruction Manual No. 14

Operation and Maintenance of

DOMESTIC WATER SYSTEM
TOWERS A&B

Final Edition
Engineering Department
Publication, November 1983

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Domestic Water System, Towers A and B, in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	Domestic Water System	1-1
	Notes On Appendices	1-2
2	DOMESTIC COLD WATER SYSTEM	
	Scope	2-1
	Description	2-1
	Water Intake System	2-5
	Pumping Stations	2-7
	Pressure Reducing Stations	2-16
	Fire System - Makeup	2-20
	HVAC Makeup	2-20
3	DOMESTIC HOT WATER SYSTEM	
	Scope	3-1
	Description	3-1
	Hot Water Preheaters	3-3
	Hot Water Heaters	3-5
	Steam Hot Water Heaters	3-5
	Electric Hot Water Heaters	3-8
	Hot Water Circulating Pumps	3-19
4	DOMESTIC WATER DISTRIBUTION	
	General	4-1
	Water Distribution - Zone 1	4-1
	Water Distribution - Zone 2	4-1
	Water Distribution - Zone 3	4-2
	Water Distribution - Zone 4	4-2
	Water Distribution - Zone 5	4-2
	Water Distribution - Zone 6	4-2

CONTENTS

Chapter		Page
5	SYSTEM MAINTENANCE	
	Scope	5-1
	General	5-1
	Maintenance Procedure Cards	5-1
	Domestic Cold Water System	5-1
	Domestic Hot Water System	5-1
	Domestic Water Pump Controls	5-1

APPENDIX A ..... Illustrations

APPENDIX B ..... Domestic Water Pump Control Reference

APPENDIX C ..... Abbreviations For Text And Illustrations

APPENDIX D ..... Mechanical Symbols

APPENDIX E ..... Electrical Symbols

APPENDIX F ..... References

CHAPTER 1

INTRODUCTION

SCOPE

The Domestic Water Systems in Towers A and B, World Trade Center, are the subject of this manual. It is divided into 5 chapters.

Chapter 1 is an Introduction. It discusses the scope of the manual.

Chapter 2 describes the Domestic Cold Water System, including the water intake system, the mechanical and electrical controls associated with the pumping stations, and the pressure reducing stations. The fire system makeup and the HVAC makeup are also discussed briefly in Chapter 2.

Chapter 3 describes the Domestic Hot Water System, including the hot water preheaters, the hot water heaters, and the hot water circulating pumps.

Chapter 4 describes the Domestic Water Distribution in the various zones.

Chapter 5 presents the maintenance procedures and schedules for the Domestic Water System.

This manual covers domestic water distribution from Floor 2 thru the roof in each tower. Domestic water distribution on the Concourse Level and the Sublevels will be covered in another manual.

DOMESTIC WATER SYSTEM

The Domestic Water Systems and equipment in Towers A and B are basically similar. A schematic diagram of a Domestic Water System is presented in Figure 1.1. This diagram applies to the Domestic Water Systems in both Towers A and B. The equipment discussed in this manual is in Tower A.

NOTES ON APPENDICES

Appendices A, B, C, D, and E are at the back of this manual.

Appendix A contains all illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains the Domestic Water Pump Control Reference.

Appendix C contains the Abbreviations For Text And Drawings.

Appendix D contains the Mechanical Symbols, with explanations.

Appendix E contains the Electrical Symbols, with explanations.

Appendix F contains the References which were used in the preparation of this manual.

232 pages

WORLD TRADE CENTER

Manual No. 15

Operation and Maintenance of

HVAC SYSTEM
TOWERS A&B

Final Edition
Engineering Department
Publication, June 1987

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information in this manual is presented as an aid to all personnel who operate and maintain the Heating, Ventilating, and Air Conditioning System in Towers A and B of the World Trade Center.

This manual should be used with, and must comply with, all Port Authority safety practices and precautions presently in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

PREFACE

The text and diagrams presented in this manual reflect the status of the Heating, Ventilating, and Air Conditioning equipment and controls as they were originally installed in Towers A and B in 1970 under WTC Contracts Nos. 502 and 511.

C O N T E N T S

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-2
	Chilled Water Plant And Distribution System . .	1-2
	Steam Service And Distribution System	1-3
	Air Conditioning Systems	1-4
	Central Control	1-7
	Notes On Text, Diagrams, And Photos	1-9
	Notes On Appendices	1-9
2	STEAM SYSTEM	
	Scope	2-1
	General	2-1
	Expansion Joints	2-2
	Pressure Reducing Stations	2-3
	Flash Tank	2-9
3	CHILLED WATER DISTRIBUTION SYSTEM	
	Scope	3-1
	General	3-1
	Differential Pressure Bypass	3-2
	Quick-Fill And Drain Valves	3-5
	Expansion Tanks	3-6

CONTENTS

Chapter		Page
4	HVAC SYSTEM	
	Scope	4-1
	Peripheral HVAC Units	4-1
	Interior HVAC Units	4-16
	Core HVAC Units	4-23
	Freight And Shuttle Elevator Machine Room HVAC Units	4-29
	Return Air Fans	4-33
	Exhaust Fans	4-38
	Main Lobby HVAC Systems	4-46
	Master Outside Air Reset Circuit	4-65
5	INTERIOR REHEAT WATER SYSTEM	
	Scope	5-1
	General	5-1
	Differential Pressure Bypass	5-3
	Expansion Tank	5-6
	Reheat Water Temperature Control	5-7
	Reheat Coil Control	5-8
6	SECONDARY WATER AND PERIPHERAL AIR CONDITIONING SYSTEMS	
	Scope	6-1
	General	6-1
	Hot Water System	6-4
	Cold Water System	6-4
	Differential Pressure Bypass	6-4
	Expansion Tank	6-7
	Temperature Control System	6-8
	Induction Units	6-11

C O N T E N T S

Chapter		Page
7	AIR DISTRIBUTION SYSTEMS	
	Scope	7-1
	Core And Interior Air	7-1
	Peripheral Air	7-2

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations For Text And Illustrations

APPENDIX C ..... Mechanical And Electrical Symbols

APPENDIX D ..... References

CHAPTER 1

INTRODUCTION

SCOPE

The Heating, Ventilating, and Air Conditioning (HVAC) System in Towers A and B of the World Trade Center (WTC) is the subject of this manual. The system is described as it was at the time of original installation.

Chapter 1 is the Introduction to the manual. The chapter contains descriptions of the general layouts of Towers A and B and the locations of the Mechanical Equipment Rooms in the towers. Also in the chapter is general information regarding: the types of air conditioning systems in the towers, the chilled water that cools the towers, and the steam that is the primary source of heat for the Trade Center.

Chapter 2 describes the steam supply to the towers and its distribution to the HVAC System.

Chapter 3 focuses on the Chilled Water Distribution System in the towers and the locations of the quick-fill and drain valves.

Chapter 4 describes the various categories of HVAC Systems and units in the towers and includes information regarding their return air and exhaust fans. The chapter also contains information regarding the Central Control System in the Trade Center.

Chapter 5 deals with the system that supplies heated water to the reheat coils in the supply ducts of the Interior Air Conditioning System.

Chapter 6 covers the Secondary Water System that provides hot and cold water for the Peripheral Air Conditioning Systems in the towers.

Chapter 7 deals with the methods by which air from the various categories of HVAC units is discharged on each floor of the towers. The chapter also describes how air is returned to the HVAC units or exhausted from the towers.

GENERAL

The HVAC design for the towers of the World Trade Center, for the most part, is traditional. After chilled water from a Central Refrigeration Plant and steam, purchased from Con Edison, are piped to a Mechanical Equipment Room (MER), both are distributed to the HVAC equipment in the same manner as in most large buildings requiring an MER of similar capacity. This system is repeated 4 times in each tower, as each tower can be considered to be 4 buildings in one, each building one above the other, and each having one MER. See Figure 1.1.

CHILLED WATER PLANT AND DISTRIBUTION SYSTEM

A Central Refrigeration Plant, located on Levels B4, B5, and B6, approximately midway between Towers A and B, produces chilled water. This chilled water is used to cool all the buildings in the

251 pages

WORLD TRADE CENTER

Instruction Manual No. 16

Operation and Maintenance of

ELECTRICAL AND MECHANICAL SYSTEMS CLUB/RESTAURANT

FOR REVIEW ONLY

Engineering Department
Publication, March 1985

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Electrical and Mechanical Systems for the Club/Restaurant at the World Trade Center.

This manual should be used with, and must comply with, the instructions set forth in the "Guide For Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division , Engineering Department, with the cooperation of the Operations Division of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-1
	Notes On Appendices	1-3
2	POWER DISTRIBUTION	
	Scope	2-1
3	SMOKE DETECTION SYSTEM, CEILING MOUNTED GENERAL ALARMS	
	Scope	3-1
	Equipment Arrangement	3-1
	Equipment Description	3-1
	Power Supply	3-7
	System Operation	3-8
4	FIRE EXTINGUISHING SYSTEM IN EXHAUST HOODS	
	Scope	4-1
	Fire Extinguishing System	4-1
	Gaylord Ventilator	4-2
5	INTRUSION ALARM CONTROL SYSTEM	
	General	5-1
	Equipment Arrangement	5-1
	Control Circuit	5-1
	Equipment Description	5-2
	System Operation	5-6

CONTENTS

Chapter		Page
6	AIR CONDITIONING AND EXHAUST SYSTEMS	
	Scope	6-1
	Ventilating Systems	6-1
	Auxiliary Systems	6-15
	Exhaust Systems	6-18
	Alarm Panel	6-20
	Auxiliary Transfer Systems	6-21
	References	6-22

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations And Definitions

APPENDIX C ..... Electromechanical Symbols

APPENDIX D ..... Reference Information

MANUFACTURERS' SPECIFICATIONS DATA

CHAPTER 1

INTRODUCTION

SCOPE

The electromechanical systems of the WTC Club/Restaurant are covered in this Manual. The electrical system discusses the power source to and its distribution within the area of the Club/Restaurant. The mechanical system is associated with the heating, ventilating, and air conditioning of the Club/Restaurant.

Chapter 1 is an introduction to the electrical and mechanical systems of the Club/Restaurant.

Chapter 2 discusses the electrical power distribution.

Chapter 3 describes the Smoke Detection System in the ceiling and ductwork.

Chapter 4 covers the Fire Extinguishing System in the exhaust hoods in the kitchen area.

Chapter 5 describes the Intrusion Alarm Control System.

Chapter 6 discusses the HVAC System and completely describes its operational aspects.

GENERAL

The Club/Restaurant of the WTC is on the 107th floor of Tower A (North Tower). In addition to describing the electrical source and distribution of the power of the Club/Restaurant, coverage is

also given to its security aspects and its fire protection systems. See Figures 1.1 and 1.2.

The HVAC system's equipment and controls are in the 108th floor MER. An outdoor master thermostat is outside the MER, in the northeast corner of the parapet. This thermostat controls the HVAC system's operations. See Figures 1.3 and 1.4. From the 108th floor MER air is moved to service the Club/Restaurant complex, which occupies the 106th and 107th floors. The HVAC units are known as 4-wall peripheral units.

In addition to these HVAC units in the 108th floor MER, the Club/Restaurant is provided with terminal reheat units to augment heating of specific spaces if necessary. The source of the heat is the interior reheat hot water system. The interior reheat units are in the ceilings of the 106th and 107th floors. These units require separate controls in the form of wall-mounted thermostats.

For proper ventilation of the Club/Restaurant, efficient exhaust systems are necessary in both the Restaurant area and the kitchen area. There are several exhaust units to service the Restaurant area. These units are in the 108th floor MER. The kitchen exhaust units have fire protective devices. These exhaust units are Gaylord Hood Exhaust Systems and they are also in the 108th Floor MER.

To achieve proper circulation of air in the various rooms, transfer fans are necessary in the Club/Restaurant. There are several such fans in the ceiling of the Club/Restaurant.

WTCI-5-P

247 pages

WORLD TRADE CENTER

Instruction Manual No. 17

Operation and Maintenance of

HVAC SYSTEM
SUBGRADE LEVELS

FOR REVIEW ONLY

Engineering Department
Publication, February 1985

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Heating, Ventilating, and Air Conditioning System for the Subgrades at the World Trade Center.

This manual should be used with, and must comply with, the instructions set forth in the "Guide For Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-2
	Notes On Appendices	1-2
2	CHILLED WATER SYSTEM	
	Scope	2-1
	Chilled Water Distribution System	2-1
3	STEAM DISTRIBUTION SYSTEM	
	Scope	3-1
	Steam Supply	3-1
	PRV Station	3-3
	Steam Metering System	3-6
4	HVAC SERVICE DESCRIPTION	
	Scope	4-1
	HVAC Equipment Location	4-1
	Air Handling Equipment Data	4-3
	HVAC Duct System	4-4
	Steam Pressures	4-5
5	HVAC CONTROL SYSTEM	
	Scope	5-1
	Control Devices	5-1
	HVAC System, Tower A	5-7
	HVAC System, Tower B	5-24
	Maintenance	5-25

CONTENTS

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations And Definitions

APPENDIX C ..... Electromechanical Symbols

APPENDIX D ..... Reference Information

APPENDIX E ..... World Trade Center Floor Level Inter-Designations

MANUFACTURERS' SPECIFICATIONS DATA

CHAPTER 1

INTRODUCTION

SCOPE

The HVAC System of the WTC subgrades is independent of the HVAC System of the WTC towers. Therefore 2 separate manuals have been prepared: WTC O&M Manual No. 15, "HVAC Systems, Towers A & B"; and this manual.

This manual describes the equipment and sequential operations of the HVAC air handling units in the subgrades. In addition, the steam and chilled water distribution systems as well as the metering setup for steam consumption are described.

Chapter 1 is an outline of the information in this manual and a general description of the HVAC System.

Chapter 2 describes the distribution of the chilled water supply and return systems.

Chapter 3 discusses the steam distribution system from the Steam Meter Room (SMR). The steam from this room serves the subgrades and the towers.

Chapter 4 describes the areas served by the HVAC equipment in the Mechanical Equipment Rooms (MERs). In addition, selected data are provided for the more important air handling equipment.

Chapter 5 discusses the controls and sequential operations for the air handling equipment. Maintenance procedures for the equipment and systems troubleshooting are also provided.

GENERAL

Heating, ventilating, and air conditioning of the subgrades in the WTC are provided via air handling equipment located mainly in the MERs on Level B6 (El. 242') in both Tower A and Tower B.

The chilled water that flows to the chilled water coils of the equipment comes from the Refrigeration Plant. (See WTC O&M Manuals Nos. 3 and 4.) The steam is supplied by Con Edison and is metered at the SMR before being distributed to the reheat and preheat coils of the air handling equipment.

NOTES ON APPENDICES

Appendices A through E are at the back of this manual.

Appendix A contains all the illustrations that support the text in each chapter. The illustrations are presented and numbered in the sequence in which they are first referred to.

Appendix B is an alphabetical listing, with definitions, of the abbreviations or designations in the text and illustrations of this manual.

Appendix C is a listing, with definitions, of the electrical and mechanical symbols in the diagrams.

Appendix D lists all the relevant reference information used in compiling this manual.

Appendix E shows the relationships between the sublevels and elevations of the WTC complex.

Behind Appendix E is a compilation of the Manufacturers' Specifications Data related to the equipment and devices in this HVAC System.

WTCI-5-P

165 pages

WORLD TRADE CENTER

Manual No. 18

Operation and Maintenance

FIRE SPRINKLER SYSTEMS

FINAL REVIEW

Engineering Department
Publication, April 1987

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Fire Sprinkler Systems in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-2
	Sprinkler Systems	1-2
	Valve Designation System	1-4
	WTC Areas	1-8
	Notes On Appendices	1-8
2	SPRINKLER WATER DISTRIBUTION LOOPS	
	Scope	2-1
	Sprinkler Loops	2-1
	Loop Interconnections	2-3
	Sectional Control Valves	2-3
	Siamese Stations	2-6
	Siamese Control Valves	2-8
	Sprinkler System Control Valves	2-9
3	COMBINATION FIRE PUMPS AND COMBINATION SPRINKLER/FSP PUMPS	
	Scope	3-1
	General	3-1
	Jockey Pump And Sprinkler Pumps	3-1
	Combination Sprinkler/FSP Pumps	3-10
	Inspection, Testing, And Maintenance Requirements And Procedures	3-15

CONTENTS

Chapter		Page
4	SPRINKLER SYSTEMS, SOUTHEAST PLAZA BUILDING	
	Scope	4-1
	General	4-1
	Riser Diagram	4-1
	Valve Locations	4-3
	System Equipment	4-3
	Alarm Condition	4-7
	Trouble Condition	4-8
	System Maintenance Procedures	4-9
	Flow Alarm Test	4-10
5	SPRINKLER SYSTEMS, NORTHEAST PLAZA BUILDING	
	Scope	5-1
	General	5-1
	Riser Diagram	5-1
	Valve Locations	5-3
	System Equipment	5-3
	Alarm Condition	5-3
	Trouble Condition	5-4
	System Maintenance Procedures	5-5
	Flow Alarm Test	5-6

CONTENTS

Chapter		Page
6	SPRINKLER SYSTEMS, SUBGRADE AND SUBLEVEL AREAS	
	Scope	6-1
	General	6-1
	Riser Diagram	6-1
	Alarm Relays	6-2
	Control Valve Locations	6-2
	Valve Designation	6-3
	Alarm Condition	6-4
	System Maintenance Procedures	6-5
	Flow Alarm Test	6-5
7	SPRINKLER SYSTEM, TOWERS A AND B	
	Scope	7-1
	General	7-1
	Riser Diagram	7-1
	System Equipment	7-4
	Sprinkler Water Storage Tanks	7-8
	Alarm Condition	7-13
	Trouble Condition	7-14
	System Maintenance Procedures	7-15
	Flow Alarm Test	7-15

CONTENTS

Chapter		Page
8	SPRINKLER HEADS	
	Scope	8-1
	General	8-1
	Types Of Heads	8-2
	Temperature Ratings, Color Coding, And Classifications	8-4
	Sprinkler Types And Locations In The Trade Center	8-5
	APPENDIX A ..... List Of Illustrations	
	APPENDIX B ..... Abbreviations For Text And Illustrations	
	APPENDIX C ..... Mechanical Symbols	

CHAPTER 1

INTRODUCTION

SCOPE

The Fire Sprinkler Systems of the World Trade Center are the subject of this manual. It is divided into 8 chapters.

Chapter 1 is an Introduction to the manual and discusses the valve designation system.

Chapter 2 describes the sprinkler water distribution loops.

Chapter 3 describes the sprinkler fire pumps.

Chapter 4 describes the sprinkler systems in the Southeast Plaza Building.

Chapter 5 describes the sprinkler systems in the Northeast Plaza Building.

Chapter 6 describes the sprinkler systems in the subgrade and sublevel areas associated with Towers A & B.

Chapter 7 describes the sprinkler systems in Towers A and B.

Chapter 8 describes the different types of sprinkler heads installed in various locations of the WTC complex.

GENERAL

There are 2 major sprinkler systems: one system serves the SEPB, the NEPB, and the subgrades and sublevels of Towers A and B; the other system serves most of the floors (1 thru 110) in Towers A and B.

SPRINKLER SYSTEMS

General

The function of the sprinkler systems is the automatic discharge of water in sufficient density to control or extinguish a fire at its very beginning, before significant damage can be done, and before public or private firefighters can possibly be on the scene.

Wet Pipe System

The sprinkler systems at the World Trade Center are the Wet Pipe type. The Wet Pipe system employs automatic sprinklers attached to pipes containing water under pressure at all times. When fire occurs, affected individual sprinklers are actuated by the heat, and they immediately release a dense spray of water. Being that there is no danger of the water freezing inside the pipes, the Wet Pipe system is used at the World Trade Center.

Sprinklers

The sprinklers are designed to spray a blanket of water over the immediate fire area. The sprinklers provide a uniform water distribution pattern, thus assuring fire-affected areas are provided with complete coverage. Random scattering of water with

253 pages

20

Instructions & Procedures

elevator system

WORLD TRADE CENTER

Manual No. 20

Instructions & Procedures

ELEVATOR SYSTEM

Final Edition
Engineering Department
Publication, October 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and procedures in this manual are presented to aid Port Authority personnel in the operations of both passenger and freight elevators at the World Trade Center during normal and emergency situations.

The manual must be used with, and must comply with, instructions in the "Guide For Port Authority Electricians", O & M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the Operations Division, World Trade Center, and the Otis Elevator staff.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General Description	1-2
	Notes On Appendices	1-4
2	NORMAL OPERATION	
	Scope	2-1
	Elevator Load Distribution	2-1
	Normal Elevator Service	2-6
3	EMERGENCY OPERATION	
	Scope	3-1
	Emergency Power System	3-1
	Emergency Power Distribution	3-2
	Emergency Elevator Operations	3-5
4	SPECIAL OPERATING PROCEDURES	
	Scope	4-1
	Firemen's Emergency Service	4-1
	Special Elevator Provisions	4-5
	Tower Sway Detection	4-18
	Operating Procedures	4-22
	Phase I	4-23
	Phase II	4-30
	Passenger Evacuation Procedures	4-36
	Building Evacuation Procedures	4-40

CONTENTS

Chapter		Page
5	ELECTRICAL CONTROL SYSTEM	
	Scope	5-1
	Elevator Power Circuit	5-1
	Elevator Control System	5-2
	Elevator Communication System	5-4

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations For Text And Illustrations

APPENDIX C ..... Reference Drawings And Contract Specifications

CHAPTER I

INTRODUCTION

SCOPE

Operational procedures for the Passenger And Freight Elevator System at the WTC during normal and emergency situations are documented in this manual.

Chapter 1 provides a general description of the system: the types of elevators in use, the Elevator Machine Rooms, and the Motor-Generator Rooms.

Chapter 2 describes the Normal Operation of the elevator system and the normal power distribution to the elevators.

Chapter 3 covers the Emergency Operation of the elevator system and the emergency power distribution to the elevators.

Chapter 4 discusses unusual conditions (e.g., high winds resulting in excessive swaying of the towers) and the special procedures necessary to safely operate the elevators under these conditions. The use of elevators during a fire emergency is also described.

Chapter 5 describes the Electrical Control System: its equipment, control panels, and visual and audible indication alarms. The chapter concludes with a description of the communication system within the elevator network.

GENERAL DESCRIPTION

Overview

Approximately 250 elevators operate in the WTC, of which about 200 are in Towers A and B. The elevators in the WTC are 3 basic types: passenger elevators, freight or service elevators (including Fire Department elevators), and combination elevators (which can be used for both passenger and freight service).

Groups of shuttle and bank elevators are provided with Elevator Machine Rooms (EMRs) and Motor-Generator Rooms (MGRs), generally located below the EMRs. The Elevator Pit (EP) is from 1 to 3 floors below the lower limit of the elevator run.

The elevators in the towers which provide express runs from the Concourse to the 44th and 78th Floor Skylobbies are called shuttle elevators. Local or bank elevators service the floors between the Concourse and the 2 skylobbies. See Figures 1.1 thru 1.6. The elevators are monitored by Elevator Starter Panels (ESPs) located on the Concourse (for all shuttle elevators, including Elevators Nos. 6 and 7) and the 44th and 78th Floor Skylobbies.

Elevator Machine Rooms

See Figures 1.1 thru 1.6. The shuttle EMRs have 2 floors. The upper floors house the DC motors, imaging cages, and controls. The lower floors house the elevator governors.

The bank EMRs have only 1 level and house the DC motors, imaging cages, AC switchgear, and controls.

Motor-Generator Rooms

See Figures 1.7 thru 1.11. The shuttle elevator MGRs are on 1 level, on which are the motor-generator sets, the motor-generator starters, and the AC switchgear. The motor-generator sets convert the AC power to DC. This DC power is distributed to the EMRs.

The bank elevator MGRs, consisting of an upper and a lower level, are on 1 floor. The bank elevator governors are on the upper level; the motor-generator sets are on the lower level.

The bank elevator MGRs are 1 floor directly below the EMRs. However, the shuttle elevator MGRs are not either directly or 1 floor below the EMRs. The shuttle elevator MGRs are: on the 41st floor for Elevators Nos. 1-5 and 8-11; on the 75th floor for Elevators Nos. 18-23; on the 76th floor for Elevators Nos. 12-17; and on the 110th for Elevators Nos. 6 and 7.

Elevator Pit

The Elevator Pit (EP) houses the blocking supports, the compensation sheaves, and the tie-down beams. The EPs for the shuttle elevators occupy between 2 and 4 floors below the lower limits of the elevator runs, whereas the (EPs) for the bank elevators occupy only 1 or 2 floors below the lower limits of the elevator runs. See Figures 1.1 thru 1.6 and 1.12.

WORLD TRADE CENTER

Manual No. 21

Operation and Maintenance

ANTENNA HEATING SYSTEM TOWER A

Final Edition

Engineering Department
Publication, December 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Antenna Heating System, Tower A, World Trade Center.

This manual should be used with, and must comply with, the instructions set forth in the "Guide For Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled and prepared by the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the Operations Division of the World Trade Center.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General	1-2
	Notes On Appendices	1-3
2	MECHANICAL SYSTEM AND EQUIPMENT	
	Scope	2-1
	Steam Distribution	2-1
	Equipment Description	2-3
	Supply And Return Air Ducts	2-7
	Maintenance	2-9
3	ELECTRICAL DISTRIBUTION SYSTEM AND EQUIPMENT	
	Scope	3-1
	Power Distribution	3-1
	Equipment Description	3-3
	Maintenance	3-10
4	HEATING OPERATIONS AND CONTROLS	
	Scope	4-1
	Sequence Of Operation	4-1
	Control, Alarm And Monitoring Systems	4-4
	Troubleshooting	4-10
	APPENDIX A ..... List Of Illustrations	
	APPENDIX B ..... Abbreviations And Definitions	
	APPENDIX C ..... Electromechanical Symbols	
	APPENDIX D ..... Reference Information	
	MANUFACTURERS' CATALOGS	

CHAPTER 1

INTRODUCTION

SCOPE

The heating and ventilating systems for the antenna housing on the roof of Tower A are described in this manual. The antenna's interior space is heated by both electrical and mechanical methods to ensure reliability of the system.

Chapter 1 provides an Introduction outlining the need for heating the antenna housing.

Chapter 2 describes: the steam distribution system; the associated piping run pertaining to the heating of the antenna's interior: and the mechanical equipment and control devices.

Chaper 3 covers: the distribution of electrical power to the heating system; the electrical heating process; and the electrical equipment and control devices.

Chapter 4 gives a description of the 4 heating stages designed to maintain a temperature of 74 degrees F inside the antenna. In addition, the control alarm and monitoring systems associated with the heating cycles are described.

180 for review

WORLD TRADE CENTER

Manual No. 22

Operation and Maintenance

COMPRESSED AIR SYSTEM

FOR REVIEW ONLY

Engineering Department
Publication, August 1988

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide Port Authority personnel who operate and maintain the Compressed Air System in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory personnel.

The contents of this instruction manual have been researched, compiled, and prepared by the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	General Description	1-2
	Notes On Appendices	1-4
2	MECHANICAL EQUIPMENT	
	Scope	2-1
	Equipment Description	2-1
	Maintenance And Troubleshooting	2-10
3	CONTROL AND ALARM DEVICES	
	Scope	3-1
	Control Devices	3-1
	Maintenance	3-8
4	SYSTEM OPERATION	
	Scope	4-1
	Main Air Compressors	4-1
	Standby Air Compressor	4-8
	Main Air Dryers	4-12
	Standby Air Dryer	4-13
	Alarm And Indication Controls	4-14
	Troubleshooting Procedures	4-19
5	ELECTRICAL SYSTEM	
	Scope	5-1
	Power Supply	5-1
	Equipment Description	5-5
	Protection System	5-8
	Maintenance	5-9

CONTENTS

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations For Text And Illustrations

APPENDIX C ..... Electrical Symbols

APPENDIX D ..... Catalog Information

APPENDIX E ..... References

CHAPTER 1

INTRODUCTION

SCOPE

The Electromechanical Systems associated with the production and delivery of compressed air between 80-190 PSI for all pneumatic control devices at the WTC, and for cleaning purposes, are described in this manual.

Chapter 1 provides a general description of the system and the locations of the equipment.

Chapter 2 describes the mechanical equipment.

Chapter 3 discusses the electromechanical control and alarm devices and their modes of operation.

Chapter 4 focuses on the sequential operation of the compressed air cycle. A troubleshooting procedure for system malfunction is also in this chapter.

Chapter 5 describes the electrical system and equipment for the Compressed Air System. Normal and emergency power for this system are outlined and the electrical equipment ia described.

Maintenance schedules are in the chapters where equipment and devices are described.

Chapter 8 covers the Spinkler System installed in all buildings and Subgrades of the Trade Center.

Chapter 9 provides information regarding the Sprinkler Waterflow Alarm System installed in the Subgrades of the Trade Center.

Chapter 10 deals with the Fire Standpipe System and hoses used throughout the Trade Center.

Chapter 11 discusses the Fire Pumps in the Sprinkler and Fire Standpipe Systems.

Chapter 12 deals with the Standpipe Fireline Communication System in the Trade Center.

Chapter 13 contains the procedures WTC Operations personnel should use to purge smoke from certain areas in the Trade Center after a fire has been extinguished.

In addition, all chapters contain inspection, testing, and maintenance requirements and procedures.

NOTES ON APPENDICES

Appearing at the back of this manual are the following appendices.

Appendix A contains the photographs and drawings that support the text in the chapters of the manual. The photographs and drawings are numbered and presented in the order in which they are first referred to in the chapters.

Appendix B comprises the abbreviations used in the text and illustrations of the manual.

WORLD TRADE CENTER

Instruction Manual No. 25

Operation and Maintenance of

SEWAGE AND SUMP SYSTEMS SUBLEVELS, TOWERS A & B

Final Edition
Engineering Department
Publication, August 1985

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the sewage and sump systems located below grade of Towers A and B (including areas J and K), in the World Trade Center, New York, New York.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by the plant supervisory staff.

The contents of this instruction manual have been researched, compiled and prepared by Syska & Hennessy, New York, with the cooperation of the World Trade Center Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department and the Operating Maintenance Staff of the World Trade Center.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	Sewage Systems	1-1
	Sump Systems	1-2
2	SEWAGE SYSTEMS	
	Scope	2-1
	System Description - Mechanical	2-1
	System Equipment	2-4
	System Operation - Electrical	2-7
	Troubleshooting Procedures	2-12
	Maintenance Procedures	2-15
3	SUMP SYSTEMS	
	Scope	3-1
	System Description - Mechanical	3-1
	System Equipment	3-3
	System Operation - Electrical	3-6
	Troubleshooting Procedures	3-14
	Maintenance Procedures	3-17

Appendix A.....Illustrations

Appendix B.....Electrical Symbol List

CHAPTER 1

INTRODUCTION

SCOPE

The subjects of this manual are the sub-level sewage systems and the sub-level sump systems for Towers A and B (including areas J and K), of the World Trade Center.

Chapter 1 is an Introduction, which includes the scope of the manual.

Chapter 2 describes the sub-level sewage systems, including the pumping stations and their mechanical and electrical controls.

Chapter 3 describes the sump systems including the pumping stations and their mechanical and electrical controls.

SEWAGE SYSTEMS

Since sewage is collected by gravity from areas of the World Trade Center which are located below the city gravity sewers, six sewage systems have been installed. These six sewage systems consist of sewage pits located at Level B-6, and two sewage ejector pumps located

WORLD TRADE CENTER

Manual No. 27

Operation and Maintenance

DOMESTIC WATER SYSTEM

NEPB

FOR REVIEW ONLY

Engineering Department
Publication, June 1988

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Domestic Water System, NEPB, in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	Water Supply	1-2
	Notes On Appendices	1-2
2	DOMESTIC COLD WATER SYSTEM	
	Scope	2-1
	System Description	2-1
	Water Meter	2-3
	Pumping Station	2-4
	Pump Control System Operation	2-10
	Air Cushion Tank	2-14
	Air Compressor	2-15
3	DOMESTIC HOT WATER SYSTEM	
	Scope	3-1
	Description	3-1
	Hot Water Preheater	3-2
	Hot Water Heaters	3-6
	Hot Water Circulating Pumps	3-11

CONTENTS

Chapter		Page
4	DOMESTIC WATER DISTRIBUTION	
	Scope	4-1
	Description	4-1
5	SYSTEM MAINTENANCE	
	Scope	5-1
	General	5-1
	Maintenance Procedure Cards	5-1
	Domestic Cold Water System	5-1
	Domestic Hot Water System	5-1
	Domestic Water Pump Controls	5-1

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Domestic Water Pump Control Reference

APPENDIX C ..... Abbreviations For Text And Illustrations

APPENDIX D ..... Mechanical Symbols

APPENDIX E ..... Electrical Symbols

APPENDIX F ..... References

CHAPTER 1

INTRODUCTION

SCOPE

The Domestic Water System in the NEPB is described in this manual. It is divided into 5 chapters.

Chapter 1 is the Introduction. It discusses the scope of the manual and describes the water supply to the NEPB. This chapter also provides a diagram showing the layout of the Domestic Water System equipment in the Mechanical Equipment Room (MER), Elevation 289'6", NEPB. The Notes On Appendices are in this chapter.

Chapter 2 describes the Domestic Cold Water System, including the: water meter, pumps, pump motors, motor controllers, low- and high-pressure switches, pressure-electric transducers, air cushion tank, and air compressor. This chapter also discusses the operation of the pump control system.

Chapter 3 describes the Domestic Hot Water System, including the preheater, hot water heaters, and hot water circulating pumps.

Chapter 4 describes the Domestic Water Distribution System in the NEPB. It provides a riser diagram showing the Domestic Water System equipment in the MER, the cold water, the hot water, and the hot water circulating lines. This chapter also contains diagrams showing the locations of isolation valves associated with:

the cold water, the hot water, and hot water circulating risers. These diagrams show the isolation valves for the tenant areas.

Chapter 5 presents the maintenance procedures and schedules for the domestic water equipment.

WATER SUPPLY

The Domestic Water System in the NEPB receives its water supply from the New York City Water System via a utility rack, which passes through the truck dock area. This utility rack extends from the northeast corner of Tower A to the southeast corner of Tower B. At both extremes of the rack are valves that can be used to isolate the rack from the street source. Water can be supplied to the system from either end of the rack. In the event one valve is closed, the system receives water from the other end.

NOTES ON APPENDICES

Appendices A,B,C,D,E, and F are at the end of this manual.

Appendix A contains all the illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains the Domestic Water Pump Control Reference.

Appendix C contains the Abbrevations For Text And Drawings.

Appendix D contains the Mechanical Symbols, with explanations.

Appendix E contains the Electrical Symbols, with explanations.

Appendix F contains the References which were used in the preparation of the manual.

WTCI-5-P

181 pages

WORLD TRADE CENTER

Manual No. 31

Operation and Maintenance

WINDOW WASHER AND EXTERIOR PLATFORM EQUIPMENT

TOWERS A AND B

Engineering Department
Publication, June 2000

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel, who operate and maintain the Window Washer and Exterior Platform Equipment associated with Towers A & B of the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures, as well as with instructions provided by plant supervisory staff.

The contents of this manual have been researched, organized and prepared by the Technical Manuals Group of the Maintenance Engineering Design Division, Engineering Department, The Port Authority of New York and New Jersey.

C O N T E N T S

CHAPTER PAGE

1 INTRODUCTION

Scope 1-1

General 1-2

Glossary 1-4

Notes on Appendices 1-5

2 ROOF CAR

Scope 2-1

General 2-1

Power Supply 2-3

Drive System 2-4

General 2-4

Operation 2-5

Hydraulic System 2-6

General 2-6

Bogie Rotation 2-8

General 2-8

Operation 2-9

Outrigger 2-10

General 2-10

Operation 2-11

Positioning System 2-12

C O N T E N T S

CHAPTER PAGE

2 ROOF CAR (Contd.)

Hoist Systems 2-13
General 2-13
Washer Hoist System 2-13
Maintenance Platform Hoist System 2-14
Control System 2-16
General 2-16
Key Switches 2-19
Selector Switches 2-20
Pushbutton Switches 2-24
Limit Switches 2-30

3 AUTOMATIC WINDOW WASHER

Scope 3-1
General 3-1
Washer Control Panel 3-2
Controls And Indicators 3-2
General 3-2
Controls 3-4
Indicators 3-7
Limit Switches 3-8
Window Washer Head 3-9

C O N T E N T S

CHAPTER PAGE

3 AUTOMATIC WINDOW WASHER (Contd.)

Mullion Washer Heads 3-10
Water Systems 3-10
General 3-10
Water Storage Tank 3-11
Water Pump And Vacuum Blower 3-12
Compressed Air System 3-12
Operating Procedures 3-13
Window Washer And Mullion Washer 3-13
Shut Down Of Automatic Washing Operation . . 3-16

4 MAINTENANCE PLATFORM

Scope 4-1
General 4-1
Hoist System 4-2
Controls 4-3
General 4-3

C O N T E N T S

CHAPTER PAGE

4 MAINTENANCE PLATFORM
(Contd.)

Controls (Contd.)

Control Station 1 4-3

EMERGENCY STOP Pushbutton (B50) 4-4

CONTROL Key Switch (B32) 4-4

PLATFORM UP Pushbutton (B44) 4-4

PLATFORM DOWN Pushbutton (B45) 4-5

Control Station 2 4-5

OPERATE (ACKNOWLEDGING SWITCH) Pushbutton (B22) 4-5

Telephone Communication 4-5

Operating Procedures 4-6

General 4-6

Control From Roof Car 4-6

Control From Maintenance Platform 4-7

Maintenance Platform Safety Switches 4-9

General 4-9

Platform Trap Door Limit Switch (B16)(Disabled) 4-9

Maintenance Platform Access Gate Limit Switches (B77 And B78) 4-10

Miscellaneous Limit Switches 4-10

C O N T E N T S

CHAPTER PAGE

5 ROOF TRACK SYSTEM

Scope 5-1

Roof Tracks 5-1

Corner Turntables 5-2

General 5-2

Disconnect Switch 5-2

Drive Motor 5-3

General 5-3

Electromagnetic Brake 5-3

Motor Controls 5-4

Turntable Control Unit 5-5

Turntable Control Circuit Limit Switch . . . 5-6

Turntable Clockwise Rotation Limit Switch . . 5-6

Turntable Counterclockwise Rotation Limit Switch 5-6

End Of Roof Track Limit Switch Operators . . 5-7

Operating Procedures 5-7

6 ROOF CAR TRANSFER PLATFORM SYSTEM

Scope 6-1

General 6-1

Transfer Platform Lift System 6-2

General 6-2

C O N T E N T S

CHAPTER PAGE

6 ROOF CAR TRANSFER PLATFORM SYSTEM (Contd.)

Transfer Platform Lift System (Contd.)

Drive Motor 6-2

Electromagnetic Brake 6-2

Motor Controls 6-3

Timing Limit Switch 6-4

Gearboxes 6-5

Torque Tubes 6-5

Jackscrews 6-6

Track Interlocks 6-6

Platform Control 6-7

General 6-7

Control Pushbuttons 6-8

Flashing Red Light 6-9

Operating Procedures 6-9

General 6-9

Transferring The Roof Car From The Garage To The Roof 6-10

Transferring The Roof Car From The Roof To The Garage 6-16

C O N T E N T S

CHAPTER		PAGE
7	MAINTENANCE INSTRUCTIONS	
	Scope	7-1
	General	7-1
	Safety	7-3
	Electrical Power	7-3
	Housekeeping	7-5
	Roof Car	7-6
	Annually	7-6
	Semiannually	7-7
	Quarterly	7-7
	Bimonthly	7-8
	Nine Times Per Year	7-8
	Automatic Window Washer	7-9
	Annually	7-9
	Semiannually	7-9
	Maintenance Platform	7-9
	Semiannually	7-9
	Corner Turntables	7-10
	Annually	7-10

C O N T E N T S

CHAPTER PAGE

7 MAINTENANCE INSTRUCTIONS
(Contd.)

Transfer Platform 7-10

Annually 7-10

Semiannually 7-10

Daily Safety Inspections 7-11

Hoist Cable Maintenance 7-13

Swage Fitting Replacement 7-13

Hoist Cable Replacement 7-16

Hoist Cable Removal 7-16

Hoist Cable Installation 7-19

Swaging 7-21

8 ELECTRICAL POWER DISTRIBUTION SYSTEM

Scope 8-1

Power Distribution Diagrams 8-1

Roof Car 8-1

Turntables 8-3

Transfer Platform And Roll-Up Door 8-3

Mercury Vapor Lamps 8-4

C O N T E N T S

Appendix A . . . . . List Of Illustrations

Appendix B . . Abbreviations For Text And Illustrations

Appendix C . . . . . Electrical Symbols

Appendix D . . . . Maintenance Schedules And Procedures

Appendix E . . . . . Shop Drawings - Window Washer

Appendix F . . . . . Manufacturers' Information

CHAPTER 1

INTRODUCTION

SCOPE

The Window Washer and the Exterior Platform Equipment associated with Towers A and B of the World Trade Center are the subject of this manual. The manual is divided into 8 chapters.

Chapter 1 is the Introduction to the manual. It briefly describes the entire system.

Chapter 2 describes the Roof Car.

Chapter 3 deals with the Automatic Window Washer.

Chapter 4 focuses on the Maintenance Platform.

Chapter 5 discusses the Roof Track System.

Chapter 6 describes the Roof Car Transfer Platform System.

Chapter 7 contains Maintenance and Inspection Schedules and Procedures.

Chapter 8 deals with the Electrical Power Distribution System.

GENERAL

On each tower the equipment consists of a Roof Car, an Automatic Window Washer, a Maintenance Platform, a Roof Track System, a Roof Car Transfer Platform System and garage, and Guideways in the columns in the tower's exterior walls. See Figures 1.1, 1.2, and 1.3.

The primary function of the Roof Car is to transport the Window Washer and Maintenance Platform horizontally on the roof and raise and lower them along the sides of the building in order to wash and maintain the windows and exterior surfaces of the building.

The Roof Car supports a Positioning System and two independent Hoisting systems. The Positioning System consists of an Outrigger, hinge-mounted at its inboard end to the Roof Car and at its outboard end, supporting a framework of four Launch Guides. See Figure 1.1.

The Window Washer is carried on the two inner Launch Guides and the Maintenance Platform on the two outer Launch Guides. Before a descent begins, the positioning system is lowered by a pair of hydraulic cylinders, so that the Launch Guides line up with the building Guideways.

An Indexing Pin on the lower end of each Launch Guide mechanically interlocks with an indexing stirrup behind each Guideway, thus ensuring alignment for the guide wheel assemblies on the Window Washer and Maintenance Platform to properly enter the Guideways on the building. After a wash cycle has been completed, the Positioning System must be

raised at least one foot so that the Roof Car can be moved to the next bay.

There are two separate Hoist Systems in the Roof Car: one for the Window Washer and the other for the Maintenance Platform. They operate independently of each other so that the Window Washer and Maintenance Platform can be used at the same time. The Maintenance Platform is designed so that the Window Washer can pass through it, if necessary.

The Roof Car, carrying the Window Washer and Maintenance Platform, moves horizontally along the roof on a track system installed on the roof. The track system includes a turntable at each corner of the building, such that the Roof Car can be turned 45 degrees for cleaning the corner, and an additional 45 degrees to proceed along the next wall.

When not in use, the Roof Car and its components are stored in the system garage on the 110th floor. A Transfer Platform is used to raise the Roof Car from the garage to the roof and lower it from the roof to the garage.

Note: In this manual the terms "left side of the Roof Car" and "right side of the Roof Car" refer to those sides of the Roof Car that are on the Roof Car Operator's left and right, respectively, when the front of the Roof Car is parallel with a side of the building and the Roof Car Operator is on the Control Platform facing that side of the building.

WTCI-5-P

WORLD TRADE CENTER

Manual No. 32

Operation and Maintenance

WINDOW WASHING AND EXTERIOR WALL MAINTENANCE SYSTEMS SEPB AND NEPB

Final Edition
Engineering Department
Publication, December 1992

THE PORT AUTHORITY OF NY & NJ

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

MEMORANDUM

TO: Thomas Cancelliere, Manager, Plant and Structures, WTC
FROM: Joseph DiSorbo
DATE: February 26, 1993
SUBJECT: **OPERATION AND MAINTENANCE MANUAL NO. 32, WINDOW WASHING AND EXTERIOR WALL MAINTENANCE SYSTEMS - SEPB AND NEPB**

COPY TO: J. Ansley, E. Auerbach, A. Brociner, J. Buchsbaum, S. Burrick, J. Castaldo, D. Chaudhuri, S. Knapp, R. Kriegel, E. Piccinich, A. Reiss, N. Spector, T. Stam, G. Tong, S. Wiener

Operation and Maintenance Manual No. 32, "Window Washing And Exterior Wall Maintenance Systems - SEPB And NEPB" was prepared under the direction of the Technical Manuals Group of the Maintenance Engineering Design Division at the request of the World Trade Department.

The manual provides operation and maintenance information and procedures, drawings, and photographs to aid the maintenance and technical staffs at the World Trade Center. We wish to thank World Trade Center personnel for their aid and cooperation during the development of the manual.

Preparation of the manual was directed by Mort Zeigen of the Technical Manauals Group. We are sending 20 copies of the manual to you for your use and distribution. If you have any questions regarding the manual, call Mort Zeigen at the Tech Center, (201) 216-2559.

Joseph DiSorbo, P.E.
Engineering Program Manager
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F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel, who operate and maintain the Window Washer And Exterior Platform Equipment associated with the Southeast and Northeast Plaza Buildings of the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures, as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by Burns and Roe Industrial Services Company, New Jersey under the direction of the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the Operations Division of the World Trade Center.

C O N T E N T S

CHAPTER		PAGE
1	INTRODUCTION	
	Scope	1-1
	Equipment Description	1-1
	Notes on Appendices	1-3
2	ROOF CARS	
	Scope	2-1
	General	2-1
	Positioning System	2-2
	Hoist System	2-3
	Power Supply	2-5
	Drive System	2-6
	Hydraulic System	2-7
	Control System	2-8
3	MAINTENANCE PLATFORM	
	Scope	3-1
	General	3-1
	Description	3-2
	Control Station	3-2
	Operating Procedures	3-5
	Safety Switches	3-8
4	ROOF TRACK SYSTEMS	
	Scope	4-1
	General	4-1
	Turntables	4-2

C O N T E N T S

CHAPTER		PAGE
5	SYSTEM OPERATING PROCEDURES	
	Transferring The Roof Car From The Storage Area To The Roof Track Southeast Plaza Building	5-1
	Transferring The Roof Car From The Roof Track To The Storage Area Northeast Plaza Building	5-3
	Operation Of Maintenance Platform . .	5-5
6	ELECTRICAL POWER DISTRIBUTION SYSTEMS	
	Scope	6-1
	Power Distribution Diagrams	6-1
	General	6-1
	Receptacle Feed Southeast Plaza Building	6-2
	Receptacle Feed Northeast Plaza Building	6-2
	208-120 Volt Transformers	6-3
	Motor Protection	6-3
7	INSPECTION AND MAINTENANCE	
	Scope	7-1
	General	7-1
	Inspection	7-1
	Maintenance	7-4
	MPC-MI - Safety Check	7-5
8	TROUBLESHOOTING	
	Scope	8-1
	General	8-1

C O N T E N T S

APPENDIX A . . . . . List of Illustrations

APPENDIX B . . . . . Abbreviations for Text

APPENDIX C . . . . . Abbreviations For Illustrations

APPENDIX D . . . . . Electrical Symbols

APPENDIX E . . . . . References

APPENDIX F . . . . . Manufacturers' Information

CHAPTER 1

INTRODUCTION

SCOPE

The Window Washing and Exterior Wall Maintenance Systems of the Southeast (Building No.4) and Northeast (Building No.5) Plaza Buildings of the World Trade Center are the subject of this manual. The manual is divided into 8 chapters.

Chapter 1 is an Introduction to the manual and describes the systems.

Chapter 2 describes the Roof Cars.

Chapter 3 focuses on the Maintenance Platforms.

Chapter 4 discusses the Roof Track Systems.

Chapter 5 deals with System Operating Procedures.

Chapter 6 discusses the Electrical Power Distribution Systems.

Chapter 7 deals with Maintenance.

Chapter 8 describes troubleshooting procedures.

EQUIPMENT DESCRIPTION

The equipment on each building consists of a Roof Car, a Maintenance Platform, an Outrigger and a Roof Track. These components are shown in Figure 1.1.

The primary function of the Roof Car is to transport the Maintenance Platform along the Roof Track System and raise or lower the Maintenance Platform to provide access to the windows and exterior surfaces of the building. The Roof Car supports a positioning system and an independent hoisting system. See Figure 1.1.

The positioning system consists of an Outrigger which is mounted on the Roof Car. Before a descent begins, the Maintenance Platform is moved over the building parapet to the face of the building by the Outrigger, so that the Face Rollers on the Maintenance Platform have continuous contact with the face of the building. After a cycle has been completed, the Platform must be lifted at least one foot above the parapet before it can be moved to the next section, and must be lifted as far as possible to clear the corners of the building.

The Hoist System incorporates two hoisting drums for the platform cables and an associated motor and gearbox.

The Roof Car, carrying the Maintenance Platform, moves horizontally on a track system installed on the roof. The track system includes a curved section at each corner of the building, so that the Roof Car can be positioned for cleaning the corner, and proceed along the next wall.

When not in use, the Roof Car and Maintenance Platform are stored on the roof.

WARNING

THIS EQUIPMENT SHOULD NOT BE USED WHEN
THERE ARE GUSTY WINDS, ELECTRICAL STORMS,
OR OTHER SEVERE WEATHER CONDITIONS.

NOTES ON APPENDICES

At the back of this manual are Appendices A thru F.

Appendix A contains all the illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B lists the abbreviations used in the text along with their definitions.

Appendix C contains the abbreviations used in the illustrations and their definitions.

Appendix D contains the electrical symbols used in the illustrations along with their definitions.

Appendix E is the list of references used in the preparation of the manual.

Appendix F contains manufacturers' information.

494 pages

WORLD TRADE CENTER

Manual No. 33

Operation and Maintenance

COMPUTER COOLING WATER SYSTEM

TOWERS A AND B

Final Edition
Engineering Department
Publication, August 1996

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information in this manual is presented to aid and guide Port Authority personnel who operate and maintain the Computer Cooling Water System in Towers A and B of the World Trade Center (WTC).

Operating and maintenance personnel must comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory personnel.

The contents of this manual have been researched, compiled, and prepared by DCI Technical Inc. and the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the mechanical maintenance staff at the WTC.

C O N T E N T S

Chapter		Page
1	**INTRODUCTION**	1-1
	Scope	1-1
	General	1-2
	River Water Input Systems	1-2
	Tower A	1-3
	System No. 1	1-3
	System No. 1A	1-3
	System No. 2	1-4
	Tower B	1-4
	System No. 5	1-4
	System No. 7	1-4
	System No. 8	1-5
	System No. 9	1-5
	Inspection and Maintenance	1-5
	Troubleshooting	1-5
	Notes on Appendices	1-5
2	**RIVER WATER INPUT SYSTEM A**	2-1
	Scope	2-1
	General	2-1
	Strainers	2-1
	General	2-1
	Manufacturer's Data	2-3
	Shutoff Valves	2-3
	General	2-3
	RWS and RWR Headers	2-4

C O N T E N T S

Chapter		Page
2	**RIVER WATER INPUT SYSTEM A (Cont.)**	
	Motor Controls	2-4
	Auxiliary River Water System Strainer Motorized Valves Control Panel	2-4
	Strainer D Control Panel	2-5
	Distribution Panel ACW-SG-3K	2-5
	Flow Alarms	2-5
	Caution Indicators	2-5
	High Differential Pressure Indicator . .	2-6
	Flow Diagram Discussion	2-6
3	**RIVER WATER INPUT SYSTEM B**	3-1
	Scope	3-1
	General	3-1
	Strainers	3-1
	General	3-1
	Manufacturer's Data	3-3
	Shutoff Valves	3-3
	Motor Controls	3-4
	Control Panel	3-4
	Automatic Mode of Operation	3-5
	Manual Mode of Operation	3-6
	Power Distribution	3-6
	Flow Diagram Discussion	3-7
4	**TOWER A**	4-1
	Scope	4-1

C O N T E N T S

Chapter		Page
4	TOWER A (Cont.)	
	General	4-1
	System No. 1	4-2
	Heat Exchangers	4-2
	General	4-2
	Nameplate Data	4-3
	Circulating Pumps	4-4
	General	4-4
	Nameplate Data	4-5
	Temperature and Flow Controls	4-5
	Local Control Panel No. 1	4-6
	Chart Recorders	4-7
	Temperature and Flow Alarms	4-7
	Temperature Alarms	4-7
	Flow Alarms (ACWP-S3-S1 and ACWP-S3-S2)	4-8
	Flow Alarms (ACWP-S3-S1A and ACWP-S3-S2A)	4-8
	Motor Controls	4-9
	ACWP-S3-S1 and ACWP-S3-S2	4-9
	Typical Control Circuit for Magnetic Motor Starter	4-10
	ACWP-S3-S1A and ACWP-S3-S2A	4-11
	Typical Control Circuit for Solid State Motor Starter	4-12
	Control Valves	4-13

C O N T E N T S

Chapter		Page
4	**TOWER A (Cont.)**	
	Expansion Tank	4-14
	General	4-14
	Operation	4-14
	Makeup Water System	4-15
	General	4-15
	Operation	4-15
	Chemical Treatment System	4-15
	General	4-15
	Operation	4-16
	Expansion Joints	4-16
	Quick-Fill and Drain System	4-16
	Domestic Water Input System	4-17
	Flow Diagram Discussion	4-17
	Riser Diagram Discussion	4-19
	System No. 1A	4-20
	System No. 2	4-21
	Heat Exchangers	4-21
	General	4-21
	Nameplate Data	4-22
	Circulating Pumps	4-23
	General	4-23
	Nameplate Data	4-23

C O N T E N T S

Chapter		Page
4	TOWER A (Cont.)	
	Temperature and Flow Controls	4-23
	Chart Recorder	4-24
	Temperature and Flow Alarms	4-24
	Temperature Alarm	4-24
	Flow Alarms (ACWP-43-1, ACWP-43-2, ACWP-43-1A and ACWP-43-2A)	4-25
	Motor Controls	4-26
	Differential Pressure Bypass	4-26
	General	4-26
	Operation	4-27
	Expansion Tank	4-28
	Makeup Water System	4-28
	Expansion Joints	4-28
	Chemical Treatment System	4-28
	Quick-Fill and Drain System	4-28
	Flow Diagram Discussion	4-29
	Riser Diagram Discussion	4-30
5	**TOWER B**	5-1
	Scope	5-1
	General	5-1
	System No. 5	5-2
	Heat Exchangers	5-3
	General	5-3
	Nameplate Data	5-3

C O N T E N T S

Chapter		Page
5	TOWER B (Cont.)	
	Circulating Pumps	5-3
	General	5-3
	Nameplate Data	5-4
	Temperature and Flow Controls	5-4
	Chart Recorder	5-5
	Temperature and Flow Alarms	5-5
	Flow Alarms	5-5
	Motor Controls	5-5
	Control Valves	5-6
	Differential Pressure Bypass	5-7
	General	5-7
	Operation	5-7
	Expansion Tank	5-7
	General	5-7
	Operation	5-8
	Makeup Water System	5-8
	General	5-8
	Operation	5-8
	Chemical Treatment System	5-9
	General	5-9
	Operation	5-9
	Expansion Joints	5-9
	Quick-Fill and Drain System	5-10

C O N T E N T S

Chapter		Page
5	TOWER B (Cont.)	
	Flow Diagram Discussion	5-10
	Riser Diagram Discussion	5-11
	System No. 7	5-12
	Heat Exchangers	5-12
	General	5-12
	Nameplate Data	5-13
	Circulating Pumps	5-14
	General	5-14
	Nameplate Data	5-15
	Temperature and Flow Controls	5-15
	Local Control Panels Nos. 1 and 2 . . .	5-16
	Chart Recorder	5-17
	Temperature and Flow Alarms	5-17
	Temperature Alarm	5-17
	Flow Alarms	5-17
	Motor Controls	5-18
	ACWP-S2-S1 and ACWP-S2-S2	5-18
	ACWP-S2-S1A and ACWP-S2-S2A	5-19
	Control Valves	5-21
	Differential Pressure Bypass	5-21
	Expansion Tank	5-22
	Makeup Water System	5-22
	Chemical Treatment System	5-22

C O N T E N T S

Chapter		Page
5	**TOWER B** (Cont.)	
	Expansion Joints	5-22
	Quick-Fill and Drain System	5-22
	Flow Diagram Discussion	5-23
	Riser Diagram Discussion	5-24
	System No. 8	5-25
	Heat Exchangers	5-26
	General	5-26
	Nameplate Data	5-27
	Circulating Pumps	5-27
	General	5-27
	Nameplate Data	5-28
	Temperature and Flow Controls	5-28
	Flow Alarms	5-29
	Motor Controls	5-29
	ACWP-43-1, ACWP-43-2, ACWP-43-1A, and ACWP-43-2A	5-29
	Control Valves	5-29
	Differential Pressure Bypass	5-30
	Expansion Tank	5-30
	Makeup Water System	5-30
	Chemical Treatment System	5-30
	Expansion Joints	5-30
	Quick-Fill and Drain System	5-31

C O N T E N T S

Chapter		Page
5	TOWER B (Cont.)	
	Flow Diagram Discussion	5-31
	Riser Diagram Discussion	5-33
	System No. 9	5-34
	Heat Exchangers	5-34
	General	5-34
	Nameplate Data	5-35
	Circulating Pumps	5-35
	General	5-35
	Nameplate Data	5-36
	Temperature and Flow Controls	5-36
	Temperature and Flow Alarms	5-36
	Motor Controls	5-36
	ACWP-75-1 and ACWP-75-2	5-36
	Control Valves	5-37
	Differential Pressure Bypass	5-38
	Expansion Tank	5-38
	Makeup Water System	5-38
	Chemical Treatment System	5-38
	Expansion Joints	5-38
	Quick-Fill and Drain System	5-39
	Flow Diagram Discussion	5-39
	Riser Diagram Discussion	5-40

CONTENTS

Chapter		Page
6	**INSPECTION AND MAINTENANCE**	6-1
	Scope	6-1
	General	6-1
	Inspection	6-2
	Expansion Tanks	6-2
	Expansion Joints	6-3
	Temperature Alarms	6-3
	Maintenance	6-4
	River Water Input Systems	6-4
	Heat Exchangers	6-5
	Circulating Pumps	6-7
	Expansion Tanks	6-9
	Control Valves	6-10
	Miscellaneous	6-11
	Addenda	6-12
	W/O Number 8858C	6-12
	W/O Number 8866C	6-13
	W/O Number 8882C	6-14
	W/O Number 8888C	6-15
	W/O Number 8890C	6-16
	Maintenance Procedure Cards	6-17
	MPC No. M-103	6-17
	MPC No. M-46	6-18
	MPC No. M-48	6-18

C O N T E N T S

Chapter		Page
6	Maintenance Procedure Cards (Cont.)	
	MPC No. M-47	6-19
	MPC No. M-98	6-19
	MPC No. M-41	6-20
	MPC No. M-99	6-21
	MPC No. M-108	6-22
7	**TROUBLESHOOTING**	7-1
	Scope	7-1
	General	7-1
	Safety Procedures	7-2
	Electrical	7-2
	Hot Surfaces	7-3
	Safety Ladder	7-3
	Housekeeping	7-3
	General Reference Troubleshooting	7-3
	Units with Electrical Connection	7-4
	Electric Motor	7-5
	River Water Input System A	7-9
	River Water Input System B	7-10
	Tower A	7-11
	System No. 1	7-11
	System No. 1A	7-13
	System No. 2	7-13

C O N T E N T S

Chapter		Page
7	Tower B	7-15
	System No. 5	7-15
	System No. 7	7-16
	System No. 8	7-18
	System No. 9	7-19
Appendix		
A	List of Illustrations	A1
B	Abbreviations for Text and Illustrations .	B1
C	Abbreviations for Drawings	C1
D	Mechanical Symbols	D1
E	Electrical Symbols	E1
F	References	F1
G	World Trade Center Floor Level Cross-Reference	G1
H	Manufacturers' Information	H1

CHAPTER 1

INTRODUCTION

SCOPE

The Computer Cooling Water System in Towers A and B of the World Trade Center (WTC) is the subject of this manual.

Chapter 1 is the introduction to the manual. Contained in the chapter is general information regarding the various systems used to provide computer cooling water to Towers A and B.

Chapter 2 describes River Water Input System A and the components that comprise the system.

Chapter 3 describes River Water Input System B and the components that comprise the system.

Chapter 4 describes the Computer Cooling Water Systems (Systems Nos. 1, 1A, and 2) of Tower A and the components that comprise each of the systems.

Chapter 5 describes the Computer Cooling Water Systems (Systems Nos. 5, 7, 8, and 9) of Tower B and the components that comprise each of the systems.

Chapter 6 contains the inspection and maintenance tasks which are required at periodic intervals for all systems listed above. Inspection and routine maintenance rosters are specified. Maintenance Procedure Cards (MPCs) are also included.

Chapter 7 contains troubleshooting procedures to aid maintenance personnel in isolating and correcting a malfunction in the Computer Cooling Water System.

GENERAL

The Computer Cooling Water System provides the WTC with a monitored water supply at a constant temperature. This water is used in the condensers of packaged air conditioners utilized by the tenants of the WTC for computer cooling purposes.

There are ten individual systems which provide computer cooling water to the WTC buildings. Systems Nos. 1, 1A, 2, 5, 7, 8, and 9, with River Water Input Systems A and B, provide computer cooling water to Towers A and B. These systems are described in this manual. See Figures 1.1-A and 1.1-B.

Systems Nos. 3, 4, 6 and 10 provide computer cooling water to the Subgrades, Concourse, Northeast Plaza Building (NEPB), and Southeast Plaza Building (SEPB). For more information on these systems, refer to WTC Operation & Maintenance Manual No. 34, "Computer Cooling Water System, Northeast and Southeast Plaza Buildings, World Trade Center." See Figures 1.1-A and 1.1-B.

RIVER WATER INPUT SYSTEMS

River Water Input Systems A and B provide river water to be used by the parent systems. The parent systems are considered to be Systems Nos. 1, 3, and 7. These systems utilize

river water to provide computer cooling water to tenants in various locations within the WTC complex.

TOWER A

System No. 1

System No. 1 is a parent (primary) system. In addition to providing computer cooling water to tenants on Floors 10 through 43 of Tower A, System No. 1 provides the auxiliary cooling water which feeds System No. 2. The auxiliary cooling water is cooled using river water supplied by River Water Input System A. When necessary, chilled water from the Chilled Water System is used to provide additional cooling capacity. In addition, when RW and the chilled water systems are not providing sufficient cooled water, a backup emergency domestic water supply is used. For information on the Chilled Water System, refer to WTC Operation and Maintenance Manual No. 3, "Mechanical Systems, Central Refrigeration Plant, World Trade Center" and WTC Operation and Maintenance Manual No. 4, "Electrical Systems, Central Refrigeration Plant, World Trade Center."

System No. 1A

System No. 1A is part of System No. 1. System No. 1A provides System No. 2 with auxiliary cooling water from System No. 1. System No. 1A is basically an additional set of supply and return risers supplying computer cooling water to Floors 10 through 40 and to the mechanical equipment room on the 43rd floor.

System No. 2

System No. 2 is a child (secondary) system. It provides computer cooling water to tenants on Floors 45 through 107 of Tower A. The computer cooling water is cooled using the auxiliary cooling water from Systems Nos. 1 and 1A.

TOWER B

System No. 5

System No. 5 is a child (secondary) system. It provides computer cooling water to tenants on Floors 14 through 24 of Tower B. The computer cooling water is cooled using the auxiliary cooling water supplied by System No. 3.

System No. 7

System No. 7 is a parent (primary) system. In addition to providing computer cooling water to tenants on Floors 5 through 40 of Tower B, System No. 7 provides the auxiliary cooling water which feeds System No. 8. When necessary, chilled water from the Chilled Water System is used to provide additional cooling capacity. For information on the Chilled Water System, refer to WTC Operation and Maintenance Manual No. 3, "Mechanical Systems, Central Refrigeration Plant, World Trade Center" and WTC Operation and Maintenance Manual No. 4, "Electrical Systems, Central Refrigeration Plant, World Trade Center." System No. 7A, which is also part of system No. 7 is primarily used for summer operation.

System No. 8

System No. 8 is a child (secondary) system. In addition to providing computer cooling water to tenants on Floors 44 through 75 of Tower B, System No. 8 also provides the auxiliary cooling water which feeds System No. 9.

System No. 9

System No. 9 is a tertiary system that provides computer cooling water to tenants on Floors 78 through 99 of Tower B. The computer cooling water is cooled using the auxiliary cooling water from System No. 8.

INSPECTION AND MAINTENANCE

Inspection and Maintenance requirements for the components of the Computer Cooling Water System are provided in the form of roster routines and MPCs. These cards outline the appropriate maintenance tasks to be performed.

TROUBLESHOOTING

Troubleshooting procedures are provided in a tabular format which includes: Troubles, their Probable Cause(s), and the Corrective Action(s) required to remedy the trouble(s).

NOTES ON APPENDICES

Appendices A through H are located at the rear of this manual.

Appendix A contains all the diagrams and photographs required to support the text in each chapter. The illustra-

tions are numbered and presented in the order in which they are first referred to.

Appendix B is an alphabetical listing, with definitions, of the abbreviations and designations used in the text and photos of the manual.

Appendix C is an alphabetical listing, with definitions, of the abbreviations and designations used in the drawings of this manual.

Appendix D is a listing, with definitions, of the mechanical symbols used in the diagrams of this manual.

Appendix E is a listing, with definitions, of the electrical symbols used in the diagrams of this manual.

Appendix F is a list of the references (drawings and publications) used in the preparation of this manual. These references should be utilized to obtain additional detailed information regarding specific components in the system.

Appendix G is a diagram of the World Trade Center Floor Level Cross-Reference.

Appendix H contains the Manufacturers' Information related to the equipment and components in the Computer Cooling Water System.

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WORLD TRADE CENTER

Manual No. 34

Operation and Maintenance

COMPUTER COOLING WATER SYSTEM NORTHEAST AND SOUTHEAST PLAZA BUILDINGS

Final Edition
Engineering Department
Publication, August 1994

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information in this manual is presented to aid and guide Port Authority personnel who operate and maintain the Computer Cooling Water System in the Subgrades, Concourse, Northeast Plaza Building (NEPB), and Southeast Plaza Building (SEPB) of the World Trade Center (WTC).

Operating and maintenance personnel must comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory personnel.

The contents of this manual have been researched, compiled, and prepared by DCI Technical Inc., and the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the mechanical maintenance staff at the WTC.

C O N T E N T S

Chapter		Page
1	INTRODUCTION	1-1
	Scope	1-1
	General	1-2
	Subgrades and Concourse	1-2
	System No. 3	1-2
	Northeast Plaza Building	1-3
	System No. 4	1-3
	System No. 10 (Dean Witter Reynolds)	1-3
	Southeast Plaza Building	1-3
	System No. 6	1-3
	Inspection and Maintenance	1-4
	Troubleshooting	1-4
	Notes on Appendices	1-4
2	SUBGRADES AND CONCOURSE	2-1
	Scope	2-1
	General	2-1
	System No. 3	2-2
	Heat Exchangers	2-2
	General	2-2
	Nameplate Data	2-3
	Circulating Pumps	2-4
	General	2-4
	Nameplate Data	2-5

C O N T E N T S

Chapter		Page
2	SUBGRADES AND CONCOURSE (Cont.)	
	Temperature and Flow Controls	2-5
	Local Control Panel No. 1	2-5
	Chart Recorder	2-6
	Temperature and Flow Alarms	2-7
	Temperature Alarm	2-7
	Flow Alarms	2-7
	Motor Controls	2-7
	Control Valves	2-8
	Differential Pressure Bypass	2-9
	General	2-9
	Operation	2-9
	Expansion Tank	2-10
	General	2-10
	Operation	2-10
	Makeup Water System	2-11
	General	2-11
	Operation	2-11
	Chemical Treatment System	2-11
	General	2-11
	Operation	2-11
	Quick-Fill and Drain System	2-12
	Flow Diagram Discussion	2-12
	Main Line Diagram Discussion	2-14

C O N T E N T S

Chapter		Page
3	NORTHEAST PLAZA BUILDING	3-1
	Scope	3-1
	General	3-1
	System No. 4	3-2
	Heat Exchangers	3-2
	General	3-2
	Nameplate Data	3-3
	Circulating Pumps	3-3
	General	3-3
	Nameplate Data	3-4
	Temperature Recorder	3-4
	Temperature and Flow Alarms	3-5
	Temperature Alarm	3-5
	Flow Alarms	3-5
	Motor Controls	3-5
	Control Valves	3-6
	Differential Pressure Bypass	3-6
	General	3-6
	Operation	3-7
	Expansion Tank	3-7
	General	3-7
	Operation	3-8
	Makeup Water System	3-8
	General	3-8
	Operation	3-8

C O N T E N T S

Chapter		Page
3	NORTHEAST PLAZA BUILDING (Cont.)	
	Chemical Treatment System	3-9
	General	3-9
	Operation	3-9
	Quick-Fill and Drain System	3-10
	Flow Diagram Discussion	3-10
	Riser Diagram Discussion	3-10
	System No. 10	3-11
	Air-Cooled Coils	3-12
	Fans	3-12
	Heat Exchanger	3-12
	General	3-12
	Nameplate Data	3-13
	Glycol Solution Circulating Pumps	3-13
	General	3-13
	Nameplate Data	3-14
	Temperature and Flow Controls	3-14
	Local Control Panel No. 1	3-14
	Local Control Panel No. 2	3-15
	Dampers	3-15
	Temperature Transmitters	3-15
	Receiver Controllers	3-16
	Temperature and Flow Alarms	3-16
	Temperature Alarm	3-16

C O N T E N T S

Chapter		Page
3	NORTHEAST PLAZA BUILDING (Cont.)	
	Dampers Fail Alarm	3-17
	Flow Alarms	3-17
	Motor Controls	3-17
	Fans	3-17
	Circulating Pumps	3-18
	Control and Isolation Valves	3-18
	Differential Pressure Bypass	3-19
	General	3-19
	Operation	3-20
	Expansion Tank	3-20
	General	3-20
	Operation	3-20
	Makeup Water System	3-21
	General	3-21
	Operation	3-21
	Quick-Fill and Drain System	3-22
	Flow Diagram Discussion	3-22
	Riser Diagram Discussion	3-23
	Sequence of Operation	3-24
	Summer Cycle	3-25
	Winter Cycle	3-26

C O N T E N T S

Chapter		Page
4	SOUTHEAST PLAZA BUILDING	4-1
	Scope	4-1
	General	4-1
	System No. 6	4-1
	Heat Exchangers	4-2
	General	4-2
	Nameplate Data	4-2
	Circulating Pumps	4-2
	General	4-2
	Nameplate Data	4-3
	Temperature and Flow Controls	4-3
	Chart Recorder	4-3
	Temperature and Flow Alarms	4-4
	Temperature Alarm	4-4
	Flow Alarms	4-4
	Motor Controls	4-4
	Control Valves	4-5
	Differential Pressure Bypass	4-6
	General	4-6
	Operation	4-6
	Expansion Tank	4-7
	General	4-7
	Operation	4-7

C O N T E N T S

Chapter		Page
4	SOUTHEAST PLAZA BUILDING (Cont.)	
	Makeup Water System	4-7
	General	4-7
	Nameplate Data	4-8
	Operation	4-8
	Chemical Treatment System	4-9
	General	4-9
	Operation	4-9
	Quick-Fill and Drain System	4-10
	Flow Diagram Discussion	4-10
	Riser Diagram Discussion	4-11
5	INSPECTION AND MAINTENANCE	5-1
	Scope	5-1
	General	5-1
	Inspection	5-2
	Expansion Tanks	5-2
	Expansion Joints	5-3
	Temperature Alarms	5-3
	Maintenance	5-3
	Heat Exchangers	5-4
	Air Cooled Condenser	5-5
	Circulating Pumps	5-6

C O N T E N T S

Chapter		Page
5	INSPECTION AND MAINTENANCE (Cont.)	
	Expansion Tanks	5-8
	Control Valves	5-9
	Miscellaneous	5-9
	Addenda	5-11
	W/O Number 8858C	5-11
	W/O Number 8866C	5-12
	W/O Number 8882C	5-13
	W/O Number 8888C	5-14
	W/O Number 8890C	5-15
	Maintenance Procedure Cards	5-16
	MPC No. M-103	5-16
	MPC No. M-46	5-16
	MPC No. M-48	5-17
	MPC No. M-47	5-17
	MPC No. M-98	5-18
	MPC No. M-41	5-19
	MPC No. M-99	5-20
	MPC No. M-108	5-21

C O N T E N T S

Chapter		Page
6	TROUBLESHOOTING	6-1
	Scope	6-1
	General	6-1
	Subgrades and Concourse	6-1
	System No. 3	6-2
	Northeast Plaza Building	6-5
	System No. 4	6-5
	System No. 10	6-7
	Southeast Plaza Building	6-10
	System No. 6	6-10

APPENDIX A . . . . . List of Illustrations

APPENDIX B . . . . . Abbreviations for Text and Photos

APPENDIX C . . . . . Abbreviations for Drawings

APPENDIX D . . . . . Mechanical Symbols

APPENDIX E . . . . . Electrical Symbols

APPENDIX F . . . . . References

APPENDIX G . . . . . World Trade Center Floor-Level Cross-Reference

APPENDIX H . . . . . Manufacturers' Specification Data

CHAPTER 1

INTRODUCTION

SCOPE

The Computer Cooling Water System (Systems Nos. 3, 4, 6, and 10) in the Subgrades, Concourse, Northeast Plaza Building (NEPB), and Southeast Plaza Building (SEPB) of the World Trade Center (WTC) is the subject of this manual.

Chapter 1 is the introduction to the manual. Contained in the chapter is general information regarding the various systems used to provide computer cooling water to the Subgrades, Concourse, NEPB, and SEPB.

Chapter 2 describes System No. 3 and the components that comprise the system. System No. 3 provides computer cooling water to the Subgrades and Concourse.

Chapter 3 describes Systems Nos. 4 and 10 and the components that comprise each of the systems. Systems Nos. 4 and 10 provide computer cooling water to the NEPB.

Chapter 4 describes System No. 6 and the components that comprise the system. System No. 6 provides computer cooling water to the SEPB.

Chapter 5 contains the inspection and maintenance tasks which are required at periodic intervals for all systems listed above. Inspection and routine maintenance rosters are specified. Maintenance Procedure Cards (MPCs) are also included.

Chapter 6 contains troubleshooting procedures to aid maintenance personnel in isolating and correcting malfunctions in the Computer Cooling Water System.

GENERAL

The Computer Cooling Water System provides the WTC with a monitored water supply at a constant temperature. This water is used predominantly in the condensers of packaged air conditioners utilized by the tenants of the WTC for computer cooling purposes.

NOTE

Computer cooling water has also been referred to as auxiliary cooling water (ACW). The piping and equipment in the Computer Cooling Water System carry the designation ACW. For this reason, computer cooling water will also be referred to as auxiliary cooling water or ACW in this manual.

There are ten individual systems which provide computer cooling water to the WTC buildings. Systems Nos. 1, 2, 5, 7, 8, and 9, with River Water Input Systems A and B, provide computer cooling water to Towers A and B. For information on these systems, refer to WTC Operation & Maintenance Manual No. 33, "Computer Cooling Water System, Towers A & B, World Trade Center." See Figure 1.1.

Systems Nos. 3, 4, 6, and 10 provide computer cooling water to the Subgrades, Concourse, NEPB, and SEPB. These systems are described in this manual. See Figure 1.1.

SUBGRADES AND CONCOURSE

System No. 3

System No. 3 is a parent system. In addition to providing computer cooling water to the Subgrades and Concourse, System No. 3 provides the water which cools Systems Nos. 4, 5, and 6. The ACW from System No. 3 is cooled by river water supplied by River Water Input System A. When necessary, chilled water from the Chilled Water System is used to provide additional cooling capacity. For information on the Chilled Water System, refer to WTC Operation and Maintenance Manual No. 3, "Mechanical Systems, Central Refrigeration Plant, World Trade Center" and WTC Operation and Maintenance Manual No. 4, "Electrical Systems, Central Refrigeration Plant, World Trade Center."

NORTHEAST PLAZA BUILDING

System No. 4

System No. 4 is a child system of System No. 3. It provides computer cooling water to the NEPB. The computer cooling water is cooled by cooling water supplied by System No. 3.

System No. 10 (Dean Witter Reynolds)

System No. 10 is an independent computer cooling system. It uses a glycol solution to provide computer cooling for Dean Witter Reynolds in the NEPB.

SOUTHEAST PLAZA BUILDING

System No. 6

System No. 6 is a child system of System No. 3. It provides computer cooling water to the SEPB. The computer cooling water is cooled by cooling water supplied by System No. 3.

INSPECTION AND MAINTENANCE

Inspection and Maintenance requirements for the components of the Computer Cooling Water System are provided in the form of roster routines and MPCs. These cards outline the appropriate maintenance tasks to be performed.

TROUBLESHOOTING

Troubleshooting procedures are provided in a tabular format which includes: Troubles, their Probable Cause(s), and the Corrective Action(s) required to remedy the trouble(s).

NOTES ON APPENDICES

Appendices A through H are located at the rear of this manual.

Appendix A contains all the diagrams and photographs required to support the text in each chapter. The illustrations are numbered and presented in the order in which they are first referred to.

Appendix B is an alphabetical listing, with definitions, of the abbreviations and designations used in the text and photos of the manual.

Appendix C is an alphabetical listing, with definitions, of the abbreviations and designations used in the drawings of this manual.

Appendix D is a listing, with definitions, of the mechanical symbols used in the diagrams of this manual.

Appendix E is a listing, with definitions, of the electrical symbols used in the diagrams of this manual.

Appendix F is a list of the references (drawings and publications) used in the preparation of this manual. These references should be utilized to obtain additional detailed information regarding specific components in the system.

Appendix G is a diagram of the World Trade Center Floor-Level Cross-Reference.

Appendix H contains the Manufacturers' Specification Data related to the equipment and components in the Computer Cooling Water System.

241 pages

WORLD TRADE CENTER

Instruction Manual No. 23

Operation and Maintenance of

FIRE PROTECTION SYSTEM

Final Edition
Engineering Department
Publication, February 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information, recommendations, and instructions contained in this manual are provided as an aid and guide to all personnel who operate the Fire Protection System of the World Trade Center.

This manual should be used in conjunction with the standard, emergency fire procedures presently in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

CONTENTS

Chapter		Page
1	INTRODUCTION	
	Scope	1-1
	Notes On Appendices	1-2
2	SPECIAL HAZARD FIRE SUPPRESSION AND EXTINGUISHING SYSTEMS	
	Scope	2-1
	General	2-1
	Kitchen Ventilating Systems	2-2
	Extinguishing Systems	2-10
	Carbon Dioxide Systems	2-16
	Steam Smothering Systems	2-19
	Halon Fire Protection Systems	2-20
3	PORTABLE FIRE EXTINGUISHERS	
	Scope	3-1
	General	3-1
	Classifications Of Fires	3-2
	Extinguisher Identification System	3-3
	Underwriters' Laboratories Ratings	3-4
	Inspection, Testing, And Maintenance Requirements	3-5
4	FIRE ALARM SYSTEM	
	Scope	4-1
	General	4-1
	Description	4-1
	Inspection, Testing, And Maintenance Requirements And Procedures	4-4

CONTENTS

Chapter		Page
5	SMOKE DETECTION AND ALARM SYSTEMS	
	Scope	5-1
	Interior Return Air Smoke Alarm System	5-1
	Elevator Lobby Smoke Alarm System	5-2
	Ventilation Smoke Alarm System	5-2
	Tenant Smoke Alarm Systems	5-3
	Inspection, Testing, And Maintenance Requirements And Procedures	5-4
6	PUBLIC ADDRESS SYSTEM	
	Scope	6-1
	General	6-1
	Speaker System	6-2
	Public Address Console	6-2
	Inspection, Testing, And Maintenance Requirements And Procedures	6-3
7	AUTOMATIC FIRE DOORS	
	Scope	7-1
	General	7-1
	Classifications	7-1
	Door Arrangements	7-3
	Automatic Operation	7-4
	Inspection, Testing, And Maintenance Requirements And Procedures	7-6

CONTENTS

Chapter		Page
8	SPRINKLER SYSTEM	
	Scope	8-1
	Towers A And B	8-1
	Subgrades, NEPB, And SEPB	8-7
	Sprinkler Heads	8-11
9	SPRINKLER WATERFLOW ALARM SYSTEM	
	Scope	9-1
	General	9-1
	Component Descriptions	9-1
	Inspection, Testing, And Maintenance Requirements And Procedures	9-3
10	FIRE STANDPIPE SYSTEM	
	Scope	10-1
	General	10-1
	Water Supply	10-1
	Hose Stations	10-4
	Riser Diagrams	10-6
11	FIRE PUMPS	
	Scope	11-1
	General	11-1
	Jockey Pump	11-2
	Sprinkler Pumps	11-3
	Fire Standpipe Pumps	11-6
	Inspection, Testing, And Maintenance Requirements And Procedures	11-9

CONTENTS

Chapter		Page
12	STANDPIPE FIRELINE COMMUNICATION SYSTEM	
	Scope	12-1
	General	12-1
	Outlying Stations	12-2
	Inspection, Testing, And Maintenance Requirements And Procedures	12-3
13	SMOKE PURGE SYSTEM	
	Scope	13-1
	General	13-1
	Towers A And B	13-2
	PATH	13-2

APPENDIX A ..... List Of Illustrations

APPENDIX B ..... Abbreviations For Text And Illustrations

APPENDIX C ..... Mechanical Symbols

APPENDIX D ..... World Trade Center Floor Level Cross-Reference

APPENDIX E ..... References

CHAPTER 1

INTRODUCTION

SCOPE

The various Fire Protection Systems in the World Trade Center (WTC) are discussed in this manual.

Chapter 1 is the Introduction to the manual and contains information regarding its contents.

Chapter 2 describes the Special Hazard Fire Suppression And Extinguishing Systems in the WTC. These systems include: kitchen ventilating, dry chemical, carbon dioxide, and others.

Chapter 3 deals with the Portable Fire Extinguishers in use throughout the Trade Center.

Chapter 4 discusses the Fire Alarm System in the Trade Center.

Chapter 5 covers the various Smoke Detection and Alarm Systems in the Trade Center.

Chapter 6 focuses on the All-Purpose Public Address System used to make announcements during fire drills or an actual fire emergency.

Chapter 7 describes the various types of Automatic Fire Doors in the Trade Center.